

**WATER CONSERVATION AND WATER DEMAND MANAGEMENT IN BUFFALO
CITY METROPOLITAN MUNICIPALITY**

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by

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DECLARATION

I, Kwanele Mlomzale hereby declare that the work contained within this research study is my original work, all sources are acknowledged and reported, and the work, in full or in part, has not been previously submitted to any other academic institution for obtaining an academic qualification.



Signature

07 December 2020

Date

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ABSTRACT

Water is one of the scarce and constrained natural resource globally, and a necessity to every living creature, organism and the natural environment – it is the existence of life. Water, as an irreplaceable natural resource, plays a vital role in every country's development and prosperity, integrating socio-economic needs of both the present and future generation. Therefore, sustainable strategies and approaches or concepts are significant in ensuring that such a unique resource is preserved and conserved sustainably.

Municipal environment or local government sphere creates a pivotal role in governing the use of water, through the provision of legislation, regulations and establishment of water conservation and water demand management strategies and plans. However, it has been established that there is a lack of integrated water resource management approach and planning in municipalities, creating concerns with regards to controlling the overutilisation of water and protection of water sources in general.

The aim and goals of the study are to review Buffalo City Metropolitan Municipality's (BCMM) water conservation and water demand management (BCMM WC/WDM) development and implementation by, assessing the existing strategy related to water conservation and water demand management; constraints and opportunity identification; and provision of recommendations in improving the practices in the municipality.

The study presents core theories and empirical studies relevant to the water conservation and water demand management, and also deals with theoretical framework found under the Natural Resource-Based View and its application to water conservation and water demand management concepts. A qualitative research design approach was used for the research, which is underpinned by a post-positivism paradigm. In terms of data collection, two methods were used in the study: (i) document study and secondary analysis; and (ii) semi-structured interviews with BCMM relevant officials.

The study identified gaps and inconsistencies in the development and implementation of BCMM WC/WDM strategy, although the municipality has taken some step towards its implementation. However, the strives taken by BCMM in implementing water conservation and water demand management initiatives are acknowledged.

The study provides recommendations related to the findings identified upon the data collection and fieldwork. The recommendation proposed by the study includes proper communicating the BCMM WC/WDM strategy to all relevant stakeholders, focus on reducing the non-revenue water, implementation of various project related to pressure management, encourage culture of

using water efficiently through educational and community awareness campaigns, capacitation of BCMM including seeking financial support, continuous review of the strategy and exploring other water supply sources to relax the already constrained existing water sources.

The limitations of the study compared to the broader scope of water conservation and water demand management aspects are highlighted and acknowledged. Thus, in the conclusion of this study, further future studies are suggested to explore other related aspects of water conservation and water demand management in BCMM.

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List of Acronyms

BCMM	Buffalo City Metropolitan Municipality
CSIR	Council for Scientific and Industrial Research
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
IDP	Integrated Development Plan
IWRM	Integrated Water Resource Management
MI/day	Mega Litres per day
NWA	National Water Act 36 of 1998
RBT	Resource-Based Theory
RWSS	Regional Water Supply System
The Constitution	Constitution of the Republic of South Africa, Act 108 of 1996
WC	Water Conservation
WD	Water Demand
WC/WDM	Water Conservation and Water Demand Management
WEF	World Economic Forum
WSA	Water Service Authority
WSDP	Water Services Development Plan
WSI	Water Services Institutions
WWF	World Wildlife Fund

Glossary

Business Plan	It should incorporate vision, mission and strategy details and ought to address water supply and water demand, finances, funding, cash-flows, cost-benefits, roles and responsibilities, risks and address various regulatory and legislative requirements (Wegelin and Jacobs, 2013)
Evaporation	Air and water vapour pressures affect the evaporation rate, depending on the temperature (for both water and air), atmospheric pressure, wind water quality and surface's shape and nature (Department of Water and Sanitation, 2014).
Integrated Water Resources Management	It is a process that promotes the co-ordinated water resources development and management as to maximise economic and social welfare, sustainably and equitably without compromising the ecosystems to sustain itself (Department of Water and Sanitation, 2014).
Non-revenue Water	Incorporates water System Inputs that are not revenue-producing and is equal to Apparent Losses plus Unbilled Authorised Consumption (Bement, 2014).
Real Losses	Water that transported through a pipeline, but unable to reach the end-user as it is lost through the water system or network (Rabe, et al., 2012).
Revenue Water	Contrary to non-revenue, it incorporates System Input components that produce revenue, and is equal to Billed Unmetered Consumption plus Billed Metered Consumption (Rabe, et al., 2012).
Unbilled Authorised Consumption	Authorised Consumption components that do not produce revenue (Department of Water Affairs and Forestry, 2004b).
Water Losses	It is the Authorised Consumption and System Input difference, which can also be a total volume of the whole water system (Department of Water Affairs and Forestry, 2004f).

CHAPTER 1: INTRODUCTION

1.1 BACKGROUND

"We never know the worth of water 'till the well runs dry" – Thomas Fuller (Fowowe, 2016)

Water is an essential environmental resource as it plays an unconditionally irreplaceable and necessary role in almost all the ecological services, such as hydrological cycle, creation of habitat, climatic regulation, and nutrient cycling (Smith, McDonald and Trinh, 2009). About 70% of our planet earth is covered by water, and we might think that is abundant; however, freshwater is extremely rare as only 3% is available for human usage or consumption (World Wildlife Fund [WWF], 2020). Thus, according to WWF (2020), about 1.1 billion people around the world has no access to water, with approximately 2.7 billion experience water scarcity at least a month per year.

As a result of an ever-increasing population, many natural water systems that keep the ecosystems flourishing and feeding the human population have become stressed (WWF, 2020). There are droughts and floods in some areas due to altered weather patterns all over the world caused by climate change, and the increasing current consumption rate is worsening the situation. Maggioni (2015) also stated that in many parts of the world, there is a problem of freshwater scarcity and due to lack of infrastructure and climate change, many poor countries are experiencing such. Meanwhile, well developed and highly industrialised countries are experiencing droughts, degradation of water quality, and conflicts amongst different consumers or users (Maggioni, 2015).

It is of a great concern that although water is a very scarce globally, South Africa is over-exploiting its freshwater resources, creating major limitation in ensuring that the country implements its development plans of accelerating its investments, transformation and economic growth (Hedden and Cilliers, 2014). Consequently, water and wastewater are essential services in any business or industry and effective delivery of such services would assist in poverty eradication and promote economic growth and development of a country.

According to King, Mitchell and Pienaar (2011), awareness of risks such as climate change, drought, floods and deteriorating water quality are emphasised, specifically in the awakening evidence of degrading water sources or catchments. Hence, efficient and effective management of water resources in South Africa is crucial to ensure that the needs of the future generation are met, as water scarcity creates constraints to the development of any country. Water management and water conservation responsibilities and accountability are very significant at

local government level, as local government is the governance sphere that gives opportunity or grounds for the implementation of every national policy, legislation or strategy.

1.2 LEGISLATIVE FRAMEWORK AND CONTEXTUAL OVERVIEW

South Africa has a ground-breaking legislative framework with regards to recognition of natural water cycle importance in human lives and the environment at large, including their basic rights to it (Colvin, Muruven, Lindley, Gordon and Schachtschneider, 2016). The Department of Water and Sanitation is governed by the National Water Act (1998) and Water Services Act (1997), and the regulator and leader of the South African water sector. Through the development of national water resources strategy, the National Water Act (NWA) set out core principles relating and in support of water conservation and water demand management (WC/WDM) by establishing management practices, general international requirements and practical measures. It is to be noted that the Department of Water Affairs and Forestry (DWAf) was divided in 2009, and the Department of Water and Sanitation (DWS) was established in 2014 (hence the different naming within this document).

As Biswas (2004) argued, water problem solutions do not only depend on the water availability, but also to many other factors such as integrated water management processes, existing legal framework appropriateness, water planning and practices, socio-political and environmental conditions, regional and international governance. Therefore, a holistic approach in managing water-related issues has been a requirement; thus, DWAf developed the Integrated Water Resources Management (IWRM) on a national level, incorporating WC/WDM components to be implemented on local government or municipal environment (Department of Water Affairs and Forestry, 2004d). This, in relevance to the study, links the IWRM with the WC/WDM concepts, and they are implemented in BCMM.

Savenije and Van der Zaag (2008) has highlighted that a country has to continuously review its policies related to water, as to ensure water management is an integrated and holistic management system and that it also meets the basic objectives and needs of socio-economic development and sustainability. Bement (2014) defines water management as the process of ensuring that the use of water resources is maximised in reducing negative impact to the environment and also balancing the consumer needs, through the development, management and distribution of water resources.

The water demand and water conservation management are incorporated under the integrated water resource management concept, with the adoption of WC/WDM active policies as key components to the IWRM plan (Department of Water Affairs and Forestry, 2003). The Department of Water Affairs and Forestry (2004d) stated that the adoption of an IWRM method

would enable incorporation of institutional roles, enabling environment and management instruments as the three framework components. Biswas (2004) gives a statement on the concept of IWRM that the integrated water resources management provide that certain feeling of using an approach that is holistic and comprehensive, of which most people will theoretically assume that will probably produce required best results, even irrespective of certain inconsistencies and its shortcomings.

Savenije and Van der Zaag (2008:290) stated that “due to nature of water, integrated water resource management needs to be considered, based on water's natural dimension, i.e. taking the whole hydrological cycle into account; the water users (human dimension with all economic interest and stakeholders); the spatial distribution of water resources and uses; and taking into account the temporal variation in availability and demand of water resources.”

1.3 OVERVIEW OF SOUTH AFRICAN WATER SUPPLY

Colvin, et al. (2016) stated the following facts with regards to freshwater in South Africa:

- South Africa's main water source (rainfall) of 490mm per annum is the half of the world's average, of which 9% goes to surface water and rivers, and 4% recharges the groundwater.
- Half of freshwater is produced by 8% of the land area in this country.
- The biggest direct consumers are farmers, who use about 66% of all water.
- The national water demand will increase to 17.7 billion cubic metres (m³) by 2030.
- When invasive alien vegetation is removed, 2076 kilolitres of water is gained.
- South African municipalities have about 37% of portable water losses in their system.

South Africa's water resources are one of the important natural capitals of the country, thus need to be protected, preserved and used in a sustainable way, and Colvin, et al. (2016) agree that it is imperative that these water resources should be restored, conserved, monitored, maintained, controlled and managed carefully.

1.4 DEMARCATION OF THE STUDY

The context for this research is BCMM, which is within the Eastern Cape Province. BCMM consist of East London, King Williams Town, Dimbaza and Bisho towns, including townships such as Mdantsane, Zwelitsha, and Ginsberg within the rural area corridors (BCMM, 2017). According to BCMM (2017), the towns and townships use an average water consumption of 60 to 320 litres/day per person; meanwhile, rural areas use 30 litres/day per person based on communal standpipes design (CSIR, 2005).

BCMM falls within the Mzimvubu-Keiskamma WMA, encompassing Gqunube, Buffalo, Kwelera, Gxulu, Tsholomnqa, Keiskamma and Nahoon River catchments (Future Works Sustainability Consulting, 2014). Thus, contained within these river catchments, there are eight main water sources (dams) supplying the entire BCMM population of approximately 834 997 (Lobanga, Crous, Brinkley, Griffioen and Ellis, 2019). A water supply schematic layout on Appendix C illustrates the water distribution of the mentioned water sources throughout BCMM. Appendix D also shows raw and potable water required for both domestic and industrial consumption in BCMM (BCMM, 2013). Table 1 below shows the Regional Water Supply Schemes, including dams, ownership and areas of supply for water conservation and water demand management information purposes.

Table 1: Regional water supply schemes and dams supplying BCMM

RWSS	DAM	WATER TREATMENT PLANT	AADD CAPACITY (Mℓ/day)	FLOW (Mℓ/day)	OWNER	AREA SERVED
Upper Buffalo	Rooikrantz and Maden	King William's Town	12.5	12.9	BCMM	KWT / Briedbach / Ginsberg
Middle Buffalo	Laing	Laing	33	28	AW (Bulk)/ BCMM (Reticulation)	Bhisho/ Balassi/ Berlin/ Ilitha/ Zwelitsha/ Pakamisa/ Ndevana/ Potsdam/ Mt. Coke/ Mdantsane
Lower Buffalo	Bridledrift	Umzoniana	120	111	BCMM (Bulk and Reticulation)	East London/ Mdantsane/ Beacon Bay/ Gonubie/ Sunrise-on-Sea/ Kwelera/ Ducats
Lower Buffalo	Nahoon	Nahoon	33	28	AW (Bulk)/ BCMM (Reticulation)	East London/ Reeston/ Mdantsane
Newlands						Newlands/ Macleantown
Wriggleswade Transfer System	Wriggleswade	None	-	-	DWS/AW	Nahoon/ Gonubie/ Yellowwoods River
		Kei Road		4.5	ADM/ AW	Kei Road/ Peelton areas
Sandile	Sandile	Sandile		18.0	DWS/ AW	Dimbaza and surroundings

Source: Lobanga, et al. (2019:21)

1.5 PROBLEM STATEMENT

Water is crucial for the growth and prosperity of a country, especially a developing country like South Africa, which is faced with challenges related to water supply (Rabe, Maree, Ramano and Price, 2012). According to Botha and Chetty (2012), South Africa is considered as the driest countries globally, with drought and floods that are extreme, in various places. BCMM is currently facing similar challenges with regards to droughts, as the municipality has implemented punitive tariffs and is on stage 3 of water restriction, meanwhile the Amatole

District Municipality has already been declared as a disaster area (BCMM Communications Department, 2020).

The major limiting factor to development and prosperity of the country is water scarcity, as water is the main source of life to both humankind, plants and animals. The growing human population is the major cause of increasing water resources contamination and water shortages (Bement, 2014). This needs creative strategies and approaches to the provision of water and effective solutions to water conservation and water demand management (WC/WDM). Considering that South Africa is currently a developing country with a growing population requiring water as a basic need, expanded access to water supplies and our increasing environmental obligations presupposes a need for more water (Dzikus, 2001). Water is one of the over-utilised and constrained natural resources, which is also becoming increasingly scarce. South Africa has been categorised as one of the countries that is water-stressed, and it is predicted to experience physical scarcity of water by 2025, with less than 1 000 m³ of freshwater available per person annually (Ochieng and Otieno, 2004). Hedden and Cilliers (2014) reported that the reason why South Africa is water-constrained is due to volatile and low water supply, coupled with poor existing resources usage and high-water demand. According to Lobanga, et al. (2019), due to the persistent drought, BCMM is experiencing low levels of water in all the dams. Water scarcity and water crisis is a major concern worldwide, as it is listed as one of the many major risks that can cause severe impact, according to the World Economic Forum (WEF) Global Risk report, which was released in 2020.

There is a prediction that freshwater resources within South Africa will be fully utilised if the present water demand growth is not changed (Department of Water Affairs and Forestry, 2004a). Although South Africa has a supply of water infrastructure resources, there is a lack of infrastructure assets condition information resulting from a decentralised and dispersed municipality water services nature (Masindi and Duncker, 2016). The country is also facing water management challenges, lack of governance, poor infrastructure, climate change, poor water quality and lesser provision of alternative supply, to mention a few. Wegelin and Jacobs (2013) also highlighted that even though there have been many publications of numerous manuals, books and over the years, there has been continuous software packages production including presentations as to assist water supply managers in developing strategies in dealing with issues of WC/WDM, many municipalities in South Africa do not have proper WC/WDM Strategy. According to Athapaththu (2016), strategic planning can be a roadmap that provides an organisation's direction and guidance based on its present situation, how and where to get to its future goals. Furthermore, a strategy, directed by a vision, is concerned with a long-term trend and a sustainable accomplishment of goals (Louw and Venter, 2013). BCMM has

existing and developing industrial areas such as Industrial Development Zone (IDZ) that need a huge amount of water for production; therefore, water conservation and water demand management interventions are required to avoid water shortages in the near future (BCMM, 2017). Thus, successful implementation is needed in order to secure an efficient supply for residents together with businesses without draining the existing water sources.

It has also been reported that the information in many existing strategies is incomplete and vague (DWAF, 2011). Although South Africa is amongst the countries facing severe droughts in the world, it has not implemented its WC/WDM effectively. One of the critical problems experienced at a local government level with regards to the implementation of WC/WDM is caused by the lack of proper planning, coordination, and proper way of communication and sharing of information, amongst other things, and being unable to be fully aware of potential benefits and consequences of water restrictions (Wegelin and Jacobs, 2013). There is also lack of WD/WDM measures, adequate knowledge and expertise within the water industry with water services institution lacking knowledge on what drives the growth in water demand (Department of Water Affairs and Forestry, 2004d).

It is a constitutional right for everyone in South Africa to have access to water (Department of Justice, 1996), and every municipality has the mandate to give priority in providing a basic level of services such as water to its local communities in a well-structured and sustainable manner.

As a requirement from the national Department of Water and Sanitation (DWS, 2014), every municipality which acts as a Water Service Authority (including authorised municipalities) is required to prioritise the planning, development and implementation of water conservation and water demand management strategy (WC/WDMS). Therefore, according to Wegelin and Jacobs (2013), it is the responsibility of municipalities to obtain funds, appoint professional services providers such as consultants and contractors, provide budget and quality control, and ensure that timelines are achieved.

1.6 RESEARCH OBJECTIVES

The aim of this research is to review the current BCMM WC/WDM strategy developed and implemented in BCMM, aligned with the WC/WDM national strategy, through the following objectives:

- Assess the current BCMM WC/WDM strategy and evaluate the progress and challenges encountered during the implementation of the strategy to date.

- Identify constraints and/or opportunities with regards to WC/WDM and make recommendations for improved practices at BCMM.

This research hopes to highlight the importance of managing water as a scarce natural resource and providing effective water services to people including the business industry, and thus focuses on the planning, development and implementation of Buffalo City Metropolitan Water Conservation and Water Demand Management (BCMM WC/WDM) strategy within the sphere of local government.

1.7 CONCLUSION

The main focus in this chapter was to outline the study background, legislative framework supporting the WC/WDM, and also to give oversight of the study in terms of providing overview of water supply in South Africa, location of the study, problem statement and the actual research objectives.

The importance of conserving water (as a scarce resource) is highlighted in this chapter and it can be confirmed that South Africa is facing challenges due to water scarcity. Thus, there is a clear indication that legislation and strategies with regard to WC/WDM should be prioritize and put in place, to ensure sustainable use of water. Local government (municipalities such as BCMM) play an important role in ensuring that such legislation and strategies are effectively implemented and monitored. Thus, the focus of the study is WC/WDM in BCMM.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

This chapter presents core theories and empirical studies relevant to the research as it relates to the problem statement discussed in Chapter 1, and also deals with the theory and its application to WC/WDM concepts.

2.2 WATER CONSERVATION AND WATER DEMAND MANAGEMENT REVIEW

2.2.1 Background

According to DWAF (1999), WC/WDM conceptual perspective is the topic that has been continuously incorporated and stated in the South African water resource management literature. However, lately, it has been identified and argued that there had been no full recognition and appreciation of the WC/WDM principles' values and need (DWAF, 1999). Reasonably, there has been evidence throughout the South African water institutes (Van Zyl and Leiman, 2002) that water is used in an unsustainable way, and its value seemed unimportant or not acknowledged by many water consumers. Viljoen and Van der Walt (2018) stated that South Africa is not only experiencing conditions of extreme drought, but its water conservation approaches, and associated records, are also poor and deficient.

2.2.2 Water Conservation and Water Demand Management Conceptualisation

According to the South African Department of Water Affairs and Forestry, water demand management (WDM) is a concept where consumers or water institutions adopt and implement a strategy as to affect the way water is used, in order to meet ideals around social equity, economic efficiency and protection of the environment (DWAF, 2004b). According to Stavenhagen, Buurman, Tortajada (2017) WDM literature review highlights policies that fall in these categories: non-tariff measures such as water awareness campaigns, operational improvements, water restrictions and regulations, and innovation in technology (such as smart-meters), meanwhile tariff measures are tariff reforms and water price increase. WDM should be regarded as a broader strategy with regards to the implementation of measures and systems related to the overall water usage and also should be linked with tariff increases and campaigns of communication (DWAF, 2004d). Consequently, water distribution and demand management from the consumer's side should be both included in the WDM. In order to ensure that future water requirements met for future development and growth, there are several possible and practical scenarios of the WDM role that can be used (Sandstrom and Singh, 2004). Furthermore, Sandstrom and Singh (2004) also stated that when using the WDM

opportunity, about 40% of existing water can be reduced without any negative impact on economic activities – making practical assumptions that there is feasibility of a full WDM potential in the water services sector.

On the other hand, Water Conservation (WC) includes environmental protection, effective and efficient water usage, and reduction of water loss or water use (DWAF, 2004a).

Thus, the concept of WC encompasses all water resources protection and effective management and should also be a strategy or an objective to water services institutions and water resources management. In acknowledging that South Africa is a water-scarce and stressed country, there is a need to establish long-term objectives of water conservation irrespective of objectives from water demand management. Van Zyl and Leiman (2002) emphasised that WC should be detached or incorporated and should be the key objective of the water services management, water resources management and as well as the national WC/WDM strategy (DWAF, 2004d). On the other hand, WDM should be viewed as an objective instead of being a strategy, as the full WDM potential cannot be understood or recognised under a context that is limited (Van Zyl and Leiman, 2002).

a) WC/WDM as a Key Sustainable Concept

Water conservation and water demand management play a significant role in outlining the sustainability concept in this research proposal. Emas (2015:1) defines sustainability as “development that meets the present generation's needs without compromising the future generation's ability to meeting their needs”. In addition to this, Pellicer-Martínez Jose and Martínez-Paz (2016) mentioned that one of the main challenges in water management is to establish how the present usage of water can be managed in order to ensure its availability to future generations and therefore, its sustainability. Wegelin and Jacobs (2013) have stated that there has been very poor implementation of WC/WDM at a municipal level, due to lack of proper planning and underestimation of the potential benefits or consequences of water restrictions. It has been estimated that 23% of water consumption in South Africa (including industrial and domestic use), occurs within the water services sector or local government, meaning that proper planning and implementation of water resource management within this sector is essential in order to balance water supply and demand (DWS, 2014).

b) Governance Arrangements concerning WC/WDM Development and Implementation

The DWAF, which is the responsible body under the National Water Act (No36 of 1998), developed a national Water Conservation and Water Demand Management Strategy (WC/WDMS) for Water Service Sectors in 2004 (DWAF, 2004c). The main aim of this

WC/WDM strategy is to establish long-term stability between water demand and available water resources, as to delay the need of large and expensive projects for infrastructure and to reduce wastage of water (DWAF, 2004d). This research will focus on the sustainable management of water through the development and implementation of WC/WDM strategies. According to the National Water Act (No 36 of 1998), the National Water Resources (NWR) strategy should be able to set out and establish principles and guidelines related to WC/WDM (DWAF, 1998). Although the NWR strategy is simple, there was a need to develop manuals or guidelines to ensure that the planning, design and implementation of water conservation and water demand measures are clearly established (DWAF, 2004c).

According to Wegelin and Jacobs (2013), it is a government mandate to provide equitable, efficient and sustainable ways of providing water to communities. Furthermore, as stipulated in the Water Services Act (No 36 of 1998), each municipality that has been authorised to be a Water Service Provider (WSP) to its communities is required to develop and present practical measures that will promote water demand and water conservation management (Wegelin and Jacobs, 2013). Municipalities are required to develop, amongst others, their own WC/WDM strategies, where these WC/WDM strategies should also incorporate some WC/WDM guidelines and measures (Wegelin and Jacobs, 2013). According to DWAF (2004c), there are five strategies that have been developed by DWAF, and WC/WDM national strategy for the service sector is one of them. The fundamentals of the overall strategy form part of the NWR strategy, which then should be promulgated in the National Water Act (No. 36 of 1998).

The WC/WDM national strategy objectives are to ensure the role of WC/WDM is achieved efficiently by instilling the culture of saving water to the consumers/users and water service institution; to promote adequate allocation of capacity and resources by water institutions; to ensure integrated planning by water management institution; and to protect the environment, ecology and water resources (DWAF, 2004d). The WC/WDM national strategy further states that within the water services sector, there should be a provision of drought contingencies, such as enforcing water restrictions, installing proper water metering control, and appropriate revenue collection and billing structure (DWS, 2014). This will raise awareness and preparedness amongst water consumers, allowing them to place contingencies in place to improve their water conservation methods and reduce their consumption effectively. Additionally, other areas of focus within the WC/WDM national strategy include the reduction of evaporation in existing water storage facilities such as dams, the reduction of water losses in existing infrastructure through pressure management application and the reduction of the amount of unaccounted water and non-revenue through the provision of water re-use strategies (DWS, 2014). McKenzie, Siquelaba and Wegelin (2012) made a concerning statement that

approximately 1580 million m³ per annum of municipal non-revenue water, representing a staggering 36.8% of total municipal water supplied, has been estimated. Thus, at a R4.50/m³ nominal production cost, this represents an estimate of R7.2billions per annum municipal revenue loss (McKenzie, et al., 2012).

c) National Water Conservation and Water Demand Management Strategy Objectives and Review

A national water conservation and water demand management strategy was established by the then DWAF (2004d) to promote and motivated the necessity for water services and resources strategies at the beginning of planning processes, design phases up to the operation, maintenances and decommissioning of water-related projects and schemes. Thus, the national strategy promotes the sustainable use of water resources by focusing on social equity, economic efficiency and a sustainable environment. According to DWAF (2004d), the national WC/WDM strategy in South Africa focuses on three major water use sectors: water services, agriculture and industry (including power generation and mines). However, this study only focuses on water services as the main objectives and location of the study are pinned under the water services sector. The following are eight objectives determined by the national WC/WDM strategy as per DWAF (2004d):

1. To provide facilitation in ensuring WC/WDM role in sustainably achieved, affordable and efficient management of water services and water resources;
2. Create a WC/WDM culture for various water users and consumers;
3. To support the implementation of WC/WDM by water services and water management institutions;
4. Promote allocation and establishment of sufficient resources and capacity by water services institutions to the WC/WDM implementation;
5. To ensure water services and management institutions adopt integrated water planning;
6. Ensure water resources, ecology and environmental protection;
7. To create WC/WDM culture within all water services and water management institutions;
8. To endorse the development of joint WC/WDM strategies by water basin sharing countries and also ensure participation and international cooperation with other countries in the Southern Africa.

DWAF (2004d) also highlighted and emphasised that the broader strategy needs to incorporate international cooperation, communication, education, public awareness programme about the WC/WDM and also establishment of alien eradication programme under the Working For Water Programmes (WfW).

Financial support is the key component in implementing the WC/WDM strategy successfully. According to Wegelin and Jacobs (2013), to implement the WC/WDM strategy effectively, financial capacity is needed, although most municipalities do not have the institutional capacity and financial support for such a strategy. Also, the current state of the South African economy is worsening the negative financial impact. On the contrary, it is an irony that municipalities in South Africa are complaining about lack of funds for their strategies (Wegelin and Jacobs, 2013). On the other hand, most financial or funding institutions are complaining that due to poor applications and strategy quality, they cannot find proper bankable projects (Wegelin and Jacobs, 2013).

There are important and basic principles that have been used in the development of WC/WDM strategies in order to attain a practical balance amongst economic efficiency, sustainable environment and social equity (DWAF, 2004d):

There is a need for water institution to develop a plan in supplying water to users in a way that is effectively and efficiently managed, i.e. through the promoting of WC/WDM objectives and minimisation of water losses in their water supply system. This can be done by ensuring that there is a reduction in water leakages at the waterworks or water supply systems up to an ideal or optimum required level. The measures implementation exercise should be continuous until the WC/WDM objectives or goals are achieved.

Water users or consumers should strive in using water sparingly or in an efficient way. Minimisation in water wastage is vital as South Africa is a water-stressed and water-scarce country. DWAF (2004) defines water wastage as the water used without any benefits which they were intended for. Water used non-efficiently is water that is used without any benefit or is used over its intended benchmark for a particular purpose (DWAF, 2004).

When planning for water supply, water resources, water services processes take place, WC/WDM should be considered and incorporated in the planning. Hence development and implementation of WC/WDM measure is vital, as it promotes suitable solutions and cost-effective ways to reconcile the ever-growing water demand on very scarce and deteriorating water resources. The integrated planning process is substantial as to provide a relevant scope of work and resources allocation for the WC/WDM activities prioritisation. WC/WDM also

can limit the capital infrastructure (such as bulk water supply, water treatment works and dams) need where water is used insufficiently.

Intervention measures under WC/WDM should be inclusive but not limited to the improved billing system, metering, leak detection and repairs, awareness campaigns, pressure management and pipeline mains replacement (DWS, 2014). Improving billing systems would result in people being conservative in their water usage, as wasteful usage results in monetary consequences. Efficient leak detection systems can result in leaks being identified immediately, therefore conserving water in the pipeline system (that is a reduction in water wastage created by burst and leaking pipelines).

Using economic efficiency, the WC/WDM paradigm shift focuses on the consumer by ensuring that there are sustainable and affordable services for water usage (Water Services Regulatory Board, 2009). WDM, therefore, requires an all-inclusive approach which identifies the inter-relationship complexity of all factors affecting water demand (Thivet and Fernandez, 2012); thus, calling for the establishment of an enabling environment grounded on suitable supportive policies and a proper legal framework with comprehensive regulatory measures in support of those policies (Thivet and Fernandez, 2012). This also highlights the importance of communicating the strategy through stakeholder engagement (Wegelin and Jacobs, 2013).

The fundamental principle for effective water conservation and water demand management is the proper application of practical and feasible WC/WDM interventions. According to Bryx and Bromberg (2009), there are a variety of the best practices initiatives being implemented to achieve the water demand management, such as educational and public awarenesses, water restrictions and water-wise building designs (featuring wastewater recycling).

On the other hand, pressure management and retrofitting can also be used in calculating the estimated savings (Wegelin and Jacobs, 2013; McKenzie, et al., 2012). They are also best practices to manage water conservation such as metering, water balance, and leak management or leak detection (Environmental Protection Agency, 2016). These are not only applicable locally but also are practised on an international level.

Communication breakdown amongst various stakeholders and institutions within the water supply environment, resulting in lack of cooperation, coordination and integration of WC/WDM information. According to Wegelin and Jacobs (2013), there is complexity in institutional arrangements particular with the urban area water supply, thus making it difficult to integrate the whole water supply chain planning. Gondal and Shahbaz (2012) further stated that breakdown in interdepartmental communication could impact the organisation efficiency and intensify stress level on employees, which can ultimately result in poor performance.

WC/WDM measures are often perceived as drought-relief tools, and the low payment of water services by the consumers even worsen the situation (McKenzie, 2014).

According to Wegelin and Jacobs (2013), approximately 44% of municipalities are unable to provide a proper water balance; thus, there is no baseline volume as a key water management information. One of the major issue when it comes to water balance in South Africa is that water is metered and billed to consumers, but there will be no recovery of payment due to high internal plumbing leaks (Mckenzie and Wegelin, 2006). However, Mckenzie and Wegelin (2006) stated that in other countries, this is not tolerated, as they have strict water bylaws. DWAF (2004b) emphasise that there is visible lack of WC/WDM strategic tools such as planning tools, appropriate information and information systems, understanding of underpinning principles, and proper guidelines in the South African context.

Although water scarcity is caused by its physical or natural scarcity, in some cases, the majority is caused by managerial or human-made factors (Mutamba, 2014). Mutamba (2014) further argues that there is a struggle with water services providers in balancing the limited water resources and ever-growing water demand. BCM's water balance has been reported on a city-wide level (GLS Consulting, 2019), and due to poor bulk meter data, present data is estimated in calculating the water balance, thus, in reality, targets pertaining water balance are not achieved (Lobanga, et al., 2019). However, in some part of the country, there is unbilled authorised consumption existing limited information, which impacts the unaccounted water component when comparing both the input and output volumes in the water balance (McKenzie, et al., 2012). McKenzie, et al. (2012) also stated that a major problem that requires attention is the inaccurate metering, billing and cost recovery, which are the key finance function in municipalities.

As WC/WDM strategies are often associated with a massive budget, there is also a challenge with financial constraints as most municipalities are unable to obtain external funding, resulting in detailed and important WC/WDM studies remaining dormant and undeveloped (Wegelin and Jacobs, 2013). According to DWAF (2004b), Water Services Institutions do not have financial muscle and resources to support the implementation of WC/WDM measures or activities, although the outcomes are a financial benefit. This is due to bottleneck and limiting regulations imposed on local authorities or government on increasing capital expenditure. It is important to calculate financial benefits on each WC/WDM measures as this will assist in further motivating for funding of any WC/WDM relevant programmes (Conward Consulting, 2007).

Another issue to development and implementation of WC/WDM is lack of political support, which is still a stumbling block in most municipalities (Wegelin and Jacobs, 2013). No interest and commitment to the WC/WDM is shown by political institution and management (lack of political will) (DWAF, 2004b). According to Conward Consulting (2007:11), a sustainable WC/WDM programme is a “relatively new function within most municipalities within South Africa, and senior management and Councillors do often not appreciate it”. However, Mckenzie and Wegelin (2006) concluded that it has been found in most cases that politicians in local level do not support WC/WDM interventions although they are enforced upon them by the Department of Water and Sanitation. Wegelin and Jacobs, (2013) emphasised the lack of proper presentation of Water Integrated Management (WIM) to the politicians on the basis of figures, facts and discussions done on a monthly basis.

d) Water Conservation and Water Demand Management Guidelines

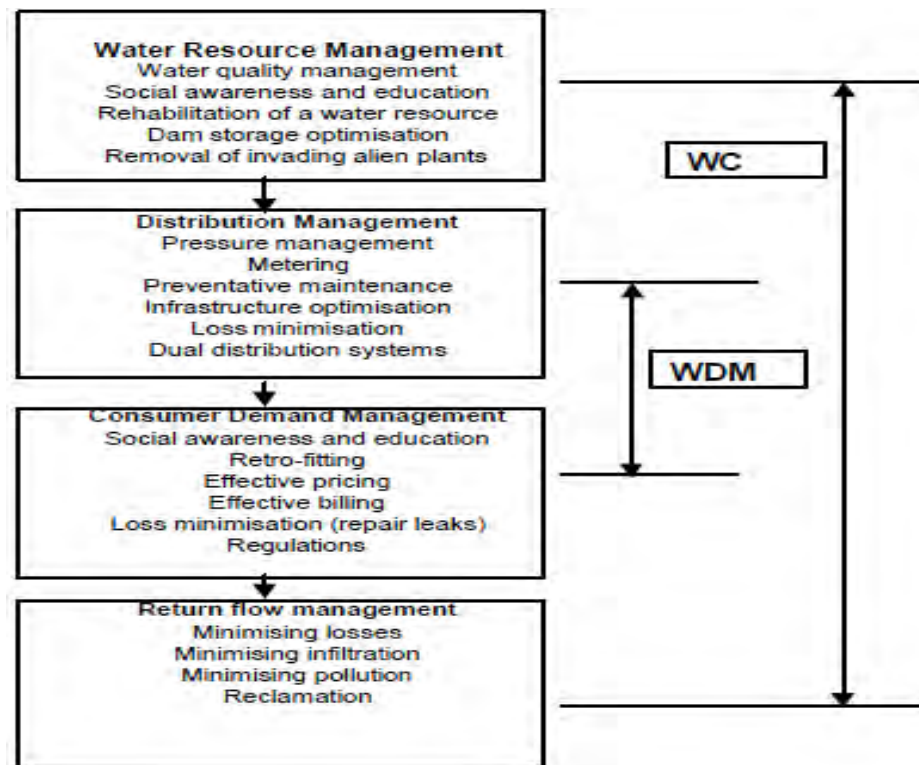
DWAF (2004f) established guidelines with the aim of assisting the water services authorities (BCMM included) in implementing WC/WDM and any related water-efficiency measures, in a sustainable way. The guidelines provide measures to be undertaken under the following WD/WDM concept – which is further discussed henceforward in the study (DWAF, 2004f):

- Water Resources Management: The various practical measures include water quality management for both surface and groundwater; and removal of alien vegetation.
- Distribution Management: Measures includes consumer meter management, pressure management, asset management, leak reduction and flow measurement.
- Consumer Demand Management: Dealing with habits in conserving water such as social awareness and education; and financial management through billing.
- Return Flow Management: Minimising infiltration; wastewater or water re-use and tariff management, are the measures applicable.
- Management and Institutional Aspects: Incorporates human resources development; institutional strengthening and capacitation; and drought management.

e) Water Conservation and Water Demand Management Linkage

In broad terms, WDM is considered as a WC component, whereby the WC concept focuses more on efficient use of water resources, while the WDM concept is centred around obtaining solutions that are beneficial to water services based on different perspectives as well as financial and social aspects (City of Cape Town, 2007). Although differences between WDM and WC are shown, it is impossible to separate these two concepts from a management perspective; thus, these concepts are frequently used as synonymous terms (DWAF, 1999).

While the WDM strategy under the Water Services Act (No 108 of 1997) focuses on non-revenue consumption reduction measures; the WC perspective, however, requires water users to adapt to conservation culture and ethics (DWAF, 2004c). According to DWAF (2004d), even though there might be different objectives between WC and WDM, it is impractical to separate their interconnected components, therefore, the WC/WDM strategy includes both concepts combined. Figure 3 below show the WC/WDM concept through the water supply chain or linkage:



Source: Department of Water and Forestry (2004c:13)

Figure 1: Water Conservation and Water Demand Management Concept

i. Water Resource Management

The DWS (2014) addresses the issue of managing water quality by giving responsibility to Water Services Institutions (which include municipalities such as BCMM) as key stakeholders in ensuring that water resources are well managed, monitored and protected. Monitoring, management, control and protection of water resources is significant as poor water quality in a catchment is unsuitable for human consumption and any other economic use which requires water pre-treatment processes (DWAF, 2004f). Although water resource management is placed under the control of DWS, it is important that BCMM, as a key stakeholder, is engaged in relations to status quo and future developments of water sources within its boundaries/catchment. As DWS owns most water storages dams that supply BCMM, therefore, also support BCMM through its functions as a water services provider (Lobanga, et al., 2019).

ii. Distribution Management

It is the responsibility of a Water Services Institution or Authority to ensure that distribution of water to consumers is well controlled, monitored and well managed as it is one of the IWRM objectives (DWAF, 2004b). This can be done through WC/WDM activities such as flow measurements, sectorisation or zone meter, water leakage reduction, pressure management, consumer-meter management and asset management (DWAF, 2004b; McKenzie, et al., 2012). According to McKenzie and Wegelin (2006), in other countries, water bylaws and policies are strict on controlling internal plumbing leaks for consumer, and this is done by applying of payment recovery from the water users with high internal leaks. BCMM's main responsibility, as a Water Service Authority, is to manage water distribution system within the municipality; thus, the WC/WDM interventions related to distribution management are duties of the municipality (BCMM, 2013a). The study evaluates whether this has been incorporated in the BCMM WC/WDM strategy.

iii. Consumer Demand Management

According to Bryx and Bromberg (2009), consumer demand management awareness such as education and public awareness has been considered as one of the WC/WDM best intervention practices. This water services phase deals or focuses on domestic, commercial and industrial water usage, but the WC/WDM measure deals more specifically on household water use. Consumer demand management is a phase where social awareness, and education campaigns play a vital role as it targets the individual consumer level (DWAF, 2004f). BCMM sees the necessity to expertise a very specific action plan through communication, education and awareness programmes to drive behavioural change and achieve consumer commitment (BCMM Communications Department, 2020).

iv. Return Flow Management

Wastewater reclamation, including water re-use strategies, is incorporated under the return flow management, to minimise losses and infiltration (DWAF, 2004b). According to Rabe, et al. (2012), less water will be disposed, and lesser water will be abstracted from existing water resources when effluent from wastewater treatment works is re-used. Thus, based on environmental benefits, augmented stream flow containing recycled or used water has the ability to recover or improve habitats within the stream, meanwhile providing increase on potable water supply (Plumlee, Gurr and Reinhard, 2012). Milne (1979) also stated that residential water consumption could be reduced by partial re-use system and also reduce the load on municipal sewer systems. Thus, incorporation of water re-use or recycling intervention is one of the WC/WDM intervention practices (Rabe, et al., 2012). The BCMM Water re-use

strategy should incorporate the possible re-use of effluent (return flow) from the wastewater treatment works (Lobanga, et al., 2019).

2.2.3 Need for Water Conservation and Water Demand Management in BCMM

According to Rabe, et al. (2012), there is a need to implement WC/WDM interventions on the water-demand side as to effectively reduce artificial demand and physical water losses. The implementation of WC/WDM measure has a holistic, sustainable benefit to both the customer, organisation and the natural environment. According to Conward Consulting (2007), WC/WDM provides the most efficient and effective measures that require no huge investments necessary for bulky water resource schemes; thus, there is a postponement of water supply capital infrastructure. Dziegielewski and Baumann (1992) alluded that water demand management initiatives and measures may reduce short-term water supply and wastewater disposal costs.

According to Maddaus (2011), key quantitative benefits with regards to water conservation are reduction in operation and maintenance due to pumping energy efficiency and lesser chemical acquisition, including treatment and disposal; reduction in water purchase from water providers; and lowering water demand can also postpone infrastructure upgrades and construction cost.

The programs associated with WC/WDM are in general, cost-effective, faster and easier to implement than the traditional programs related to water supply (Rabe, et al., 2012). Financial risks caused by misjudged or miscalculated future water demand can be reduced, as predictions of such future demands can be complex and uncertain due to drought, economic or pandemic impacts (Conward Consulting, 2007).

WC/WDM measures can also reduce the effluent volume that needs to be treated, which results in environmental benefit as treated return flow volumes to natural water sources are decreased (DWAF, 2004f). Therefore, overall, base and peak water demands can be reduced through water use efficiency.

According to DWAF (2004f) and Conward Consulting (2007), WC/WDM ensures sustainable, basic and necessary service delivery specifically to low-income households, in an effective and efficient manner; thus, WC/WDM programmes are the catalysts in reducing non-revenue water, reduce leakage and reduce water accounts to acceptable and affordable levels for individuals. Some WC/WDM activities and programs such as retrofitting are labour intensive, thus creating jobs opportunities to the communities such as plumbing or any other semi-skilled work (DWAF, 2004f; Maddaus, 2011). Provision of equity through reasonable or fair tariffs.

Financial savings or benefits from the WC/WDM can be redirected to other community-needs services (DWAf, 2004f). While there is a possible increase in water tariffs, the overall to utility costs would automatically reduce as influenced by lower-cost providing water services.

2.3 NATURAL RESOURCE-BASED VIEW OUTLINED

2.3.1 Introduction

Although the relevant literature is outlined, the underpinning theoretical framework for this research is found in the Natural Resource-Based View (NRBV). The hypothesis is in discovering the linkage between the organisational effectiveness and its pollution preventing. In consideration, the use of NRBV highlights on how the organisation can adjust competences or capabilities in the ever-changing markets.

2.3.2 Theoretical Rationale

NRBV is one of the theories founded upon the organisation's relationships to the natural environment, and in ensuring this, the Resource-Based Theory (RBT) has key elements such as a resource and a capability which focus on the organisation's internal factors that contributes to a sustained competitive benefit. According to Hart (1995), the emphasis in the RBT is that; for an organisation to have a continuous competitive advantage, a resource should be rare, valuable, unique, and be supported by complex processes within the organisation. The value created in the resource allows stakeholders to have a willingness toward sustaining it and its rareness provides an organisation to command quality and avoid competition in the market. However, there is an omission in the RBT (Hart, 1995), where it ignores the interaction between an organisation and the natural environment. Thus, this can create a serious constraint towards the organisation's sustainability developments. NRBV contrast, however, that sustainable development, product stewardship and pollution prevention are important capability strategies. On the other hand, Madhok, Li and Priem (2010) specified that the NRBV views organisations as collections of evolving capabilities and resources managed for the purpose of earning. Therefore, firms or organisations deploy strategies for the purpose of making, enhancing and capturing economic rents (Madhok, et al., 2010).

According to Hart and Dowell (2011), it is suggested that sustainable development research should be done in a more case-comparative and qualitative approach; however, it is also argued that in the mid-90s it was rare to find large manufacturing firms which were committed to this sustainable development vision. Gupta (2015) further argues that there is a significant controversy with regards to the comparative advantage and its application, as either the competitive advantage framework/model interprets it inaccurately or regards it as useless.

Comparative advantage can be defined as that special ability of a country or organisation to provide service or product fairly more economically than other services (Madhok, et al., 2010).

Technological superiority and resource endowment (such a human skills) are considered dynamic elements supporting comparative advantage (Gupta, 2015). Porter (1990) defines comparative advantages as so-called production factors such as labour, natural resources, land and financial capital. Balashova-Kostadinova (2017) clearly illustrate the comparative advantages of territories related to a municipality in Table 2 below:

Table 2: Comparative advantages of territories

Type of comparative advantage:	Possible variations:
Natural resources (Mulec and Wise, 2013)	Geographical position and size of territory; Geological resources; Climate; Water resources (rivers, lakes, sea); Landscape; Specific flora and fauna; Balneology resources.
Socio-Economic resources (Bumleitner, 2014)	Economic structure (available production); Socio-demographic structure – population characteristics, migration, professional training, special education; Political and administrative structure – local government, decision-making process.
Infrastructure and available services (Tonkova, 2015)	Transport – public transport, good conditions of highways and local roads, railway and airport availability; Public services like healthcare, security, educational infrastructure, sports and recreational infrastructure; Available amenities – gas, electricity, waste processing, water services.

Source: Balashova-Kostadinova (2017:42)

As per Table 2, BCMM can utilise comparative advantages such as its natural water resources, social-economic resources (including professional training, political and administrative structures), infrastructure and available services related to water in enhancing its WC/WDM strategy. Thus, the availability of resources does provide a source of comparative advantage (Gupta, 2015). According to the natural resource-based view, competitive advantage can only be sustained when resources creating organisation capabilities are available and used in a proper manner (Hart, 1995). Physical assets such as infrastructure, financial assets, human capital (i.e. employees' capabilities and skills) and social or organisational processes are the basic "resources" described in the natural resource-based view concept. According to Wegelin and Jacobs (2013), municipalities need financial capacity to implement WC/WDM strategy successfully; meanwhile, Masindi and Duncker (2016) stated that infrastructure assets conditions are one of the key concerns when it comes to water services issues in municipalities. Also, BCMM has to prioritise the capacitation of its employees dealing with WC/WDM strategy, to ensure that the strategy is developed and implemented successfully.

The hypothesis-testing is suggested to be done on pollution prevention constructed strategies, as they are strategies adopted by a wide range of existing firms/organisations. This shows that mostly the application of NRBV focused on pollution-prevention and lesser on sustainable development and products stewardship strategies imperial research. NRBV assists in providing a theoretical technique whereby linkage between actions towards the environment and profitability can be established; as a key question to this research are whether there is a benefit or loss in improving environmental performance based on short-term performance financially (Hart and Dowell, 2011). Therefore, NRBV has been developed with the linkage with the operational resources of the firm/organisation and the challenges of the natural environment.

However, these impose a significant impact on the natural environment, as Hart (1995) stated that there is also a multiplication of environmental impacts associated with such activities. Furthermore, Hart and Dowell (2011) argue that the natural environment could seriously create constraints for organisations trying to establish such sustainable advantages. As per the BCMM Integrated Development Plan (BCMM, 2017) there is a challenge in balancing the people's need when it comes to water usage (water demand) and conserving the already scarce water resources, thus highlighting the important need for WC/WDM interventions in BCMM (Lobanga, et al., 2019). Thus, BCMM effectively utilises its comparative advantage of territories in developing and implementing key WC/WDM strategy to ensure that it maximises the already constrained water resource in a sustainable manner and, on the other hand, creating effective revenue collection to sustain itself as the organisation (BCMM, 2013). This will ensure a proper balance between the already scarce natural water usage and meeting the socio-economic needs of the present and future generation.

As much as it is important to focus on sustainable use of water as a scarce resource, the national WC/WDM strategy also emphasises the protection of water sources from pollution, and that responsibility has been given to Catchment Management Agents such as Water Boards to authorise water use for water service sectors, such as BCMM (DWAF, 2004d). This supports the NRBV's stewardship aspect in terms of key strategies to consider for improved comparative advantage, which can be translated as improved service delivery and operational efficiency from a municipal perspective. Protection of water resources from pollution is one of the key functions of CMA (DWAF, 2004), further linking the underpinning NRBV concept to improved water management within a municipal area.

2.4 CONCLUSION

The chapter presented core theories and empirical study relevant to the research as it relates to the problem statement discussed in the previous chapter, and also deals with theoretical framework and its application to water conservation and demand management concepts.

Literature shows that WC/WDM can be used as a sustainable concept with regards to water saving, and also, there are various ways in which it can be developed and implemented through the use of numerous interventions within the municipal environment. Practical guidelines in implementing the WC/WDM concept through various phases of the water supply chain are also highlighted. Also, the literature framework highlights that NBRV supports comparative advantage of an organisation (municipality in this case) in improving water related service delivery and ensuring efficient and effectiveness of WC/WDM strategy.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter encompasses research paradigm which underpins the study, thus providing a viewpoint of understanding reality of the research, and also it provides a critical view on the selection of research techniques undertaken, data collection, sampling method, data analysis, research validation, ethics consideration and the study's limitations. It provides a detailed methodology structure on how the study commenced.

3.2 RESEARCH METHODOLOGY AND PARADIGM

Igwenagu (2016) defined research methodology as systematic techniques set that provides a guide to the research on how it has to be conducted, and furthermore, it provides methods description and analysis, highlighting on their resources and limitations, bringing clarity to their consequences and presuppositions, and relating to their potentialities at the knowledge frontiers. Furthermore, Huysamen (1996) clearly states that any applied research methodology in any case for any purpose should create conclusions that are justifiable and accountable, as it is imperative to increase knowledge in a reasonable and responsible manner.

In this study, a qualitative research design approach is used in the form of a case study evaluation or assessment approach (De Vos, Strydom, Fouche and Delport, 2011). Creswell (2003) describes the case study approach as a systematic strategy associated with qualitative research, where it incorporates an investigation of individual or activities, events and processes. As per Robson (2002:178) case study definition, empirical investigation is established for the current BCMM WC/WDM strategy implementation, using multiple collected sources of evidence. Case study is relevant in this research, as multiple sources of evidence such as interviews, visual documents, questionnaires, participant recordings and observations can be used (Bryman and Bell, 2011). Rather than a comprehensive statistical survey, a case study is an in-depth or a detailed research problem study (Mouton, 1996).

According to De Vos, et al. (2011), the main purpose of qualitative research is to produce findings, as data is then transformed into findings by qualitative analysis (Patton, 2002:432). Then De Vos et al. (2011) further states that this involves raw material volume reduction, scrutinising significance from trivia, identifying important patterns and creating a framework for communicating the essence of what is revealed by the data. Thus, this chapter outlines data collected and consolidated for the purposes of evaluating the content and the context of WC/WDM in BCMM. As previously discussed in the previous chapter, thematic analysis was used to analyse the data collected through interviewing of selected participants; meanwhile,

documentary study and secondary analysis were dealt through the application of content analysis.

Yin (2011) describes features contained in qualitative research, which are also much relevant to this study, as follows:

- Representing people's views and perspective in a study and meaning of people's lives under real and practical conditions;
- Covering of contextual conditions of communities or where people live and contributing understanding into emerging or existing concepts which might explain the social behaviour of a human being; and
- Motivates to use various sources of evidence rather than relying on a single source.

Thus, qualitative enable data collection, integration, data presentation and analysis from a source variety as part of this study. This study is also underpinned by a post-positivism paradigm (Guba and Lincoln, 1994). Barker (2003:312) defines a paradigm as a “pattern containing a set of assumptions” assumed to be legitimate and design system of collected and interpreted data. Thus, it is a framework of assumptions and philosophies about the knowledge nature and social world, and how the researcher views and interprets the gathered material about reality, in order to guide action to be taken (De Vos, et al., 2011:513). Also, Kivunja and Kuyini (2017) simplify a paradigm as a way of telling how meaning and reasoning can be constructed or created from a collected data, based on an experience of an individual's background.

In post-positivism research paradigm, there is critical realism as reality is assumed to exist but is not perfectly apprehendable due to the flawed mechanism of human intellectual and difficult phenomena nature (Guba and Lincoln, 1994). The research methodology selected for this study provides an integrated approach in evaluating the WC/WDM measures and possible interventions within BCMM.

Thematic analysis is a data pattern classifying, analysing and reporting method (Vaismoradi, Turunen and Bondas, 2013) and was used for document analysis. This is also a method to identify, analyse and report theme or a pattern within data (Braun and Clarke, 2006). Content analysis was also used for interviews as this allows a researcher to make a repeatable and valid conclusion reached on the basis of evidence and reasoning. Content analysis is a common term for different strategies used in text analysis, and it is also used for categorising and coding methods used to explore large quantities of textual information as to determine the frequency, patterns, structures, trends of words used including the discourse of communication (Powers and Knapp, 2006; Gbrich, 2007; Vaismoradi, et al., 2013).

3.3 DATA COLLECTION TECHNIQUES

Data collection methods in the research include collecting and examining documents (document study and secondary analysis) and conducting interviews (Yin, 2011). A qualitative interview, according to Yin (2011), is a procedure whereby the objective is to reveal meanings and interpretation of research participants, based on their point of view; thus it should be taken as a conversation rather than a tightly-scripted setup or format, where "leading" questions should be avoided.

Yin (2011:130) defines "data" is an organised and prearranged information which may consist of words, images or numbers, mostly as observations or measurements of variables set. As mentioned, this study focused on document study and secondary analysis and interviewing.

3.3.1 Interviewing

Interviewing is the most predominant mode of collecting information or data in qualitative research, as researchers gather information through straight interchange with a known individual participant or a group whose is expected to have knowledge or expertise about the subject (DePoy and Gilson, 2008:108; De Vos, et al., 2011:342).

A semi-structured interview approach was used for the study. Initially, the interview questions were articulated as to obtain appropriate and relevant information with regards to BCMM WC/WDM strategy (the interview schedule is attached in Appendix A). The aim of the interview questions were to gather more information which would supplement the qualitative data information from the documents. The questions were asked at the strategic level through the participation of programme managers and managers, at a tactical level using engineers and senior technicians and at an operational level using technicians as participants. Participants (managers) were selected from three departments that are key role players in the development and implementation of BCMM WC/WDM Strategy.

The interview questions (see Appendix A) were not in sequential arrangement but were formed on the basis of grasping the overall content of the BCMM WC/WDM strategy. Participants were allowed to answer all the questions; however, those who felt some questions were not relevant to their roles and responsibilities were unable to answer those irrelevant questions.

3.3.2 Document study and Secondary Analysis

According to Ritchie and Lewis (2003:35), document study is the analysis of documents which involves the collection and study of existing documents, neither to illuminate deeper meanings nor substantially understand their content, which may be revealed by their coverage or stylishness. Meanwhile, secondary analysis is an empirical exercise on an already collected

data, and the researcher usually starts after the completion of the data's primary analysis (De Vos, et al., 2011:383).

Available documents from BCMM for this study are the BCMM 2016/2021 Integrated Development Plan (IDP), BCMM 2017/2018 IDP Review Report; BCMM Water Services Development Plan (WSDP) (2019), BCMM 2013/2014 WC/WDM Strategy, latest Audit Reports, Business Plans, non-revenue/water loss quarterly reports, and infrastructure maintenance project reports. The researcher was given access to the BCMM database, and other documents were sent through emails and in hardcopies.

3.4 POPULATION AND SAMPLING

In the BCMM's water service supply department, consisting of twenty (20) employees (i.e. two programme managers, a senior engineer, three district engineers, six senior technicians and eight technicians), ten (10) employees were selected as representatives of each management level: i.e. two participants (programme manager plus senior engineer) represented the strategic/senior management levels, four participants (two district engineers plus two senior technicians) represented tactical/medium management levels, and four technicians represented operational levels. Also, an addition of two participants from Disaster Management, and the Finance (Billing) or Communications departments were interviewed. Therefore, the total number of participants were twelve (12) in maximum and ten (10) was the minimum requirement. Nine (09) employees from water services supply department were interviewed instead of the proposed ten (10), as the previous senior engineer for planning resigned at the end of 2018, and the newly appointed senior engineer did not avail herself to be interviewed. Two other employees from supporting department were interviewed, thus, making the total number of interviewed participants to eleven (11). The participants were selected based on the experience and understanding of water conservation and water demand aspects, and knowledge of municipal WC/WDM strategy.

Relevant people from the mentioned departments were selected to give insight and information relating to WC and WDM elements; thus, purposive sampling was used. The kind of documents purposively sampled for the research included BCMM WC/WDM strategy, IDP reports, Water Services Development Plan, business plans, water audit, reports, non-revenue/water loss quarterly reports, and infrastructure maintenance project reports (such as water pipeline and meter replacement, retro-fittings and pressure management). Purposive sampling (Yin, 2011:311) is the source of data or participants selection for study use, based on their relevant information and anticipated richness with regards to the research questions or objectives of the study. Furthermore, Yin (2011) accentuated that such richness and relevance include source

whose data is supposed not to just support but to challenge the thinking of the researcher about the research questions.

3.5 VALIDATION OF QUALITATIVE RESEARCH

According to Burns (2000), a paradigm is usually validated by four criteria application such as reliability, objectivity, external and internal validity. To improve reliability, the study has used various information sources to collect data through the use of documents and interviews with relevant personnel with expertise on the research topic.

Triangulation method was used in the study as information was collected from various different sources. Yin (2011:81) stated that in research, the principle related to the goal of seeking three ways of substantiating or verifying a specific description, fact, or event being reported by the study. He further highlighted that such verification serves as another technique of strengthening the study validity.

3.6 ETHICAL CONSIDERATIONS

The researcher is part of the organisation where the research was conducted and was aware of the ethical implications and therefore understood that this research had to be based on acceptance, mutual trust, cooperation, promises and well-accepted expectations and conventions between all those involved in this project (De Vos, et al., 2011). Key principles to manage bias according to Galdas (2017), is an evidence-based practice, in ensuring that researchers have the skills and knowledge to use checklist and tools to critically assess the evidence's trustworthiness and relevance. Rhodes University ethical procedures were followed, and permission from the University and BCMM to conduct this study were obtained and approved (see attached Appendix B).

The interview sessions had been recorded, and the interviewees were informed of the recording prior to the interview. Participants' names are not mentioned in the study. Also, the desire of the researcher in ensuring that the research will have an impact on the organisation is credible and necessary (Galdas, 2017). These are some of the ethical issues that were dealt with:

- Avoidance of harm (Babbie, 2007:27) and voluntary participation (Rubie and Babbie, 2005).
- Informed consent: An informal consent has been obtained, the proposal has been approved, and formal consent from the employer was given.
- The researcher has gone through the Rhodes Business School's internal ethical clearance processes for approval.

3.7 STUDY LIMITATIONS

The study is based on the data collected through document study, secondary analysis and interviews; thus, there might be the possibility of inaccuracies and unreliable or objective information. De Vos, et al. (2011) stated that since documents are not intended for the purpose of research, there might be factors that influence their objectivity, and also reports, historical documents or statistical records may contain incomplete information resulting in database gaps that cannot be filled in any other way. The disadvantage of relying on secondary analysis is that written sources cannot accurately and authentically reflect certain human behaviour aspects such as attitude, feelings and non-verbal communication; thus, data may contain some errors that the researcher may be unable to detect (De Vos, et al., 2011).

3.8 CONCLUSION

In this chapter, the research methodology and research paradigm have been discussed in detail, where a qualitative research approach and post-positivism paradigm has been used in this study. Data collection techniques were discussed, and the techniques used in the study included interviewing, document study and secondary analysis, where thematic analysis and content analysis were used respectively. Triangulation method was used for the validity of the research. Ethical processes for this research were considered, discussed and followed, and also evidence is provided and attached as Appendix B.

CHAPTER 4: RESULTS, FINDINGS AND DISCUSSIONS

This chapter provides qualitative data collection, findings and analysis of the study in BCMM, with the aim of achieving the main objectives of the study, as indicated in Chapter 1. The following research objectives in alignment with the national WC/WDM strategy (DWAF, 2004d) formed the basis of the study topic, which is discussed and analysed in this chapter:

- To assess the current BCMM WC/WDM strategy and evaluate the progress and challenges encountered during the implementation of the strategy to date.
- To identify constraints and/or opportunities with regards to WC/WDM and make recommendations for improved practices at BCMM.

Processes to be followed in this study were outlined in the previous chapter. Through the consolidated data collection, key findings are identified and discussed with the intention to attain the main objectives of the study.

4.1 INTRODUCTION

As discussed in the previous chapter, two data collections techniques are used in the study, which formed part of the findings and discussions in this chapter. The selected and mentioned documents were used to provide data that relates to the study objectives, where thematic analysis approach is used for identifying linkages and alignments of information.

Also, as discussed in the study, semi-structured interview sessions were conducted with BCMM officials within the water supply services department, financial/billing department, communications department and disaster management department, with regards to the BCMM WC/WDM strategy (BCMM, 2013) development and implementation. The water supply services department is the responsible department to implement the BCMM WC/WDM strategy (BCMM, 2013) and its organogram is attached as Appendix F. The participants were categorised in term of implementation levels, i.e. strategic level (management including programme and general managers), tactic level (engineers and senior technicians) and the operational level (technicians). In order to validate the confidentiality of the participants, no names were mentioned, but only levels of responsibility such as Managers, Engineers, Senior Technicians and Technicians were used to group the participants.

4.2 RESEARCH OBJECTIVE 1:

Alignment of BCMM WC/WDM Strategy (BCMM, 2013) with the National WC/WDM Strategy (DWAF, 2004d)

The Department of Water Affairs and Forestry (now DWS) requires each Water Service Authority (BCMM in this case) to develop and implement strategy related to water conservation and water demand management, to establish long-term stability between water demand and available water resources (DWAF, 2004c). A national WC/WDM strategy framework and guideline to WC/WDM were then established by DWAF (2004d) to assist the municipalities in drafting their WC/WDM strategies.

Therefore, in this study, the national WC/WDM strategy (DWAF, 2004d), together with the Guidelines (DWAF, 2004f) to WC/WDM were used to assess whether the BCMM WC/WDM strategy (BCMM, 2013) is aligned with the national requirements. Chapter 2 discussed the national WC/WDM strategy (DWAF, 2004d) key fundamental objectives in developing and implementing WC/WDM, which the municipalities need to align their WC/WDM strategies. These fundamental objectives are outlined to obtain key findings related to the BCMM WC/WDM strategy (BCMM, 2013) and discussed henceforth.

4.2.1 Findings and Discussions with regards to Alignment of BCMM WC/WDM Strategy (BCMM, 2013) with the National WC/WDM strategy (DWAF, 2004d)

In the financial year of 2012/2013, BCMM developed a WC/WDM strategy, based on its reported high non-revenue water reported in the previous years and also to enhance both the water supply sustainability and financial viability.

“The municipality established a partnership with the Amatola Water Board and Department of Water and Sanitation (DWS) in ensuring the implementation of the WC/WDM strategy as per the BCMM IDP report (BCMM, 2017).” (BCMM WC/WDM Strategy Report, 2020)

BCMM WC/WDM Review Report (2019) also stated:

“The integrated nature of WC/WDM necessitates good inter-departmental co-operation and communication, especially between the Engineering and Finance Departments, together with Executive Support Services: Communication - communication is a key component of WC/WDM (GLS Consulting, 2019).”

However, the interviewees felt that the partnership is not effective enough towards the WC/WDM strategy implementation due to lack of communication and coordination between the various stakeholders. The following quotes illustrate this point:

“I feel that the strategy is not communicated well, even internally. I was not even aware of some information contained in the strategy, yet I am in the department that supposed to implement it...” (Respondent 6, BCMM, 2020)

“The top management is supposed to involve other key stakeholders such as Amatola [Water] Board about the issue involved in implementing the [WC/WDM] strategy, and nothing is happening.” (Respondent 4, BCMM, 2020)

“...also, the filtering down of information is not adequate in my view, because you will find out that people who are doing the actual work on the ground, are not informed technically.... I think the more information we get, the more we will feel that we are part of the solution.” (Respondent 9, BCMM, 2020)

Under the national WC/WDM strategy (DWAF, 2004d) objectives discussed in Chapter 2 of this thesis, DWAF (2004d) has emphasised on the WC/WDM strategy cooperation, communication and education. Breakdown of communication, complexity in institutional arrangements have a negative impact in implementing the strategy, which can also result in poor performance amongst the employees (Wegelin and Jacobs, 2013; Gondal and Shahbaz, 2012).

The BCMM IDP (2017) report, the BCMM WSDP (2019) and BCMM WC/WDM strategy review report (2019) have mentioned the adoption of various policies and water bylaws:

“The development of WC/WDM should be implemented through the adoption of policies and bylaws, and also the drafting of appropriate water plumbing bylaws in low-income households to assist with water-efficiency initiatives (BCMM, 2017; Lobanga, et al., 2019).”

The interviewees felt that the BCMM WC/WDM strategy (BCMM, 2013) has policies and bylaws that promotes the implementation of WC/WDM, based on the following comments:

“BCMM WC/WD is aligned mainly with the efficient operation, effective management, efficient use and control of water demand and revenue enhancement strategy policies.” (Respondent 2, BCMM, 2020)

“The water services bylaws put an emphasis [on] water conservation and water demand management. And the financial department has a strategy (the revenue

enhancement strategy). So, that revenue enhancement strategy speaks of water conservation and water demand management.” (Respondent 9, BCMM, 2020)

As per the water Distribution Management is concerned, water bylaws and water-related policies should be strictly applied in controlling internal water plumbing leaks (Mckenzie and Wegelin, 2006). Also, adoption of water-related policies and initiative by water service institution is part of water demand management (Rabe, et al., 2012).

The following findings emerged from the document analysis and interviews, which are also linked to the National Water Conservation and Water Demand Management Strategy Objectives discussed in the literature review chapter:

a) To provide facilitation in ensuring WC/WDM role in sustainably achieved, affordable and efficient management of water services and water resources

Information obtained from the documents highlighted the following:

“The BCMM WC/WDM strategy had been developed with the aim of reducing non-revenue water, as to enhance financial capability and sustainable water supply of the municipality (BCMM, 2013; GLS Consulting, 2019). One of the BCMM WC/WDM strategy objectives is to promote water use efficiency to increase water availability (BCMM, 2017).” (BCMM WC/WDM strategy, 2013; BCMM WC/WDM strategy review report, 2019; BCMM IDP review report, 2017)

A supporting statement from the interviews is as follows:

“The departmental role is to ensure that the water services infrastructure is well managed, maintained and protected for sustainable use. A strategy is a departmental tool used to achieve effective, efficient, affordable, economical and sustainable access to water services.” (Respondent 2, BCMM, 2020)

b) Create a WC/WDM culture for various water users and consumers

The BCMM WSDP (2019) stated the following with regards to instilling the WC/WDM culture to various stakeholders:

“The BCMM WC/WDM strategy incorporated water use efficiency initiatives such as routine community awareness and educational campaign programmes (BCMM, 2013).”

These programmes are discussed in detail in terms of progress under Research Objective 2. This was also confirmed from the interview session, as one of the interviewees said:

“We currently implementing the water awareness programme that focused on schools, clinics and shopping malls, providing various platforms for water wastage reporting such as WhatsApp social media.” (Respondent 5, BCMM, 2020)

c) Promote allocation and establishment of sufficient resources and capacity by water services institutions to the WC/WDM implementation

It is suggested in the national WC/WDM strategy that the role of Water Service Authority municipalities should be to incorporate WC/WDM in the WSDP and develop institutional capacity to fulfil the WC/WDM objectives (DWAF, 2004d).

As per the information obtained from the BCMM WC/WDM strategy (2013) and the BCMM WSDP (2019):

“...institutional capacity should be developed through the development of the internal technical, administrative and financial system; recruitment and training of technical staff; and, when necessary sensitisation and training of senior management and political structure (BCMM, 2013; Lobanga, et al., 2019).”

Also, the BCMM WSDP (2019) stated:

“There are still critical vacancies under the water services department, and the technical staff capacity needs to be improved (Lobanga, et al., 2019).”

During the interviews, the technical interviewees agreed that the water department is under-capacitated, and there is no adequate training even to the existing staff related to WC/WDM:

“...although we sometimes attend pressure management training, I feel more training is needed in our department so that everyone is well-equipped when it comes to water conservation and water demand management.” (Respondent 10, BCMM, 2020)

“Due to financial constraints, we are unable to fill critical positions at the moment, although this has been continuously reported to the Council.” (Respondent 1, BCMM, 2020)

d) Ensure water resources, ecology and environmental protection; and also, to ensure water services and management institutions adopt integrated water planning

Although the BCMM WC/WDM strategy (BCMM, 2013) promotes the removal of alien vegetation on water sources, such as dams, BCMM does not have control over dams as they are owned by DWS and controlled by Amatola Water Board (GLS Consulting, 2019). Therefore, this is creating a gap with regards to the objective. This brings huge concerns as the national WC/WDM strategy (DWAF, 2004d) emphasise on integrated water planning and

management approach to achieve an effective WC/WDM implementation (DWS, 2014). One of the interviewees stated the following, with regards to the statement:

“...most of the dams that supply BCMM are owned by Department of Water and Sanitation. The only dam that BCMM owned (Bridle drift) has an active dam inspection report which is updated every five years. This is used as a tool that provides the risk of the dam.” (Respondent 3, BCMM, 2020)

As per these findings, it can be identified that there are gaps and misalignment of the BCMM WD/WCM strategy (BCMM, 2013) with regards to national WC/WDM strategy requirements (DWAF, 2004d). One of the major factors is the lack of communicating the WC/WDM strategy to key stakeholders. Communicating a strategy is a continuous process, as Knights (2019) stated that governance processes should focus on the strategy implementation and enhancement - which is a steady and continuous form of communication, rather than shouting and then being silent.

It also emerged that finance and budget allocation is the major constraint when it comes to the effective implementation of the BCMM WC/WDM strategy (BCMM, 2013), as indicated by the BCMM WSDP (2019) and BCMM WC/WDM strategy review reports (2019):

“Budget allocation within specific financial years has been erratic and do not allow for systematic planning of WDM projects (Lobanga, et al., 2019; GLS Consulting, 2019).”

Financial support is the key component in implementing the WC/WDM strategy successfully, as Wegelin and Jacobs (2013) stated that to implement the WC/WDM strategy effectively, financial capacity is needed, although most municipalities do not have the institutional capacity and financial support for such strategy.

4.3 RESEARCH OBJECTIVE 2:

Assessment of the current BCMM WC/WDM strategy (BCMM, 2013) and evaluation of the progress and challenges encountered during the implementation of the strategy to date.

The assessment was done by relating or linking the BCMM WC/WDM strategy (BCMM, 2013) objectives or goals with the national WC/WDM strategy (DWAF, 2004d), such as Water Resource Management, Distribution Management, Consumer Demand Management and

Return Flow Management (which were discussed in details in the literature review of the study).

The BCMM WC/WDM strategic (BCMM, 2013) objectives information found in the WC/WDM strategy document information assisted in reviewing and evaluating the development and implementation progress and outcomes. As per the document analysis, the BCMM WC/WDM strategy objectives or goals are as follows (BCMM, 2013):

- **Non-revenue water reduction:** reduction of 39% of supplied water volume by 32.5% within 2 years; 27.5% within 3 years; and 22.5% in 5 years.
- **Increase billed metered consumption** from 49.5% to 55% in 2 years; 57.5% in 3 years; and 62.5% in 5 years.
- **Ability to undertake a detailed water balance:** Establish and conduct a detailed bulk and reticulation water balancing per WTW supply zones; per reservoir supply zone; and per subzone.
- **Water use efficiency promotion** through community awareness programmes; routine schools educational programmes; provincial government engagement; and appropriate design standards and plumbing by-laws, specifically for low-income households.
- **WC/WDM Institutional capacity enhancement:** the WC/WDM should be adopted within a year from its development; budget be allocated on a 3-year MTEF; political and official champions be appointed; interdepartmental task team to oversee and review the strategy establishment; reporting structures and requirements establishments; and appropriate structured Water Services department.

4.3.1 Findings and Discussion for Research Objective 2

It should be noted that the BCMM WC/WDM strategy (BCMM, 2013) should be reviewed annually, as required by DWS (Lobanga, et al., 2019; BCMM, 2013); however, the strategy was reviewed only once in 2019. The information found from the document analysis such as the BCMM WC/WDM strategy (BCMM, 2013) review report and BCMM WSDP together with water audit reports will assist in assessing the progress and challenges encountered.

The previously mentioned BCMM WD/WCM strategy goals/objectives are discussed in detail, with the aim of highlighting progress and challenges as per the research objective hereafter.

i) Non-revenue water reduction

This objective falls under the Distribution Management phase as per the WC/WDM concept (DWAF, 2004b) discussed in chapter 2 of this study.

One of the major goals of the BCMM WC/WDM strategy (BCMM, 2013) was to drastically reduce the municipal non-revenue water (NRW) to 22.5% after five years of strategy inception.

The BCMM quarterly Audit for 2018/19 financial year reported the following:

“Non-revenue water of 46.11% (BCMM Water Supply Services Department, 2019), which is higher than the required target of 39%.”

Therefore, the goal was not achieved. Table 3 below show the progress of the non-revenue water reduction objective. From the table below, it can be seen that although the NRW percentage has dropped from 43.7% to 34.1%, the targets as per the strategic goals were not met.

Table 3: Comparison of BCMM non-revenue water goals and recorded progress

Target date	NRW% goal	NRW% as reported by water department	Goal achieved?
2012-06 (Inception)		47.3%	
2014-06 (2 years)	32.5%	39.5%	Goal not achieved
2015-06 (3 years)	27.5%	34.4%	Goal not achieved
2017-06 (5 years)	22.5%	34.1%	Goal not achieved

Source: GLS CONSULTING (2019:29)

Comparing this to the WC/WDM strategic objectives of reducing non-revenue water to less than 40%, highlights the challenges in regards with effective implementation of WC/WDM interventive measures. According to the strategic review report, there has been a confusion between water loss and NRW as the percentage of NRW at inception was reported as 39.6%, the actual NRW value reported by Water services department was at 47%.

This probably is caused by interpretation and understanding of WC/WDM concepts such as water balance, which was also stated by the interviewee:

“Our reported revenue water is not the true reflection of what is happening on the ground. I think it’s because the numbers are being manipulated, for example in BCMM as Water and Sanitation [internal department] we use to only account for what has been sold.... In the later years, a water balance IWA formula was amended in SA to include free basic water as part of non-revenue.” (Respondent 3, BCMM, 2020)

Therefore, from the statement, this means the inclusion of free basic water as non-revenue water would have increased the overall BCMM non-revenue water as per the water balance. Appendix E shows water consumption categories under the revenue water and non-revenue water differentiation. According to McKenzie, et al. (2012), municipalities cannot produce a

proper water balance; thus, WC/WDM intervention projects are identified and implemented based on perception without proper water management information.

ii) Increase billed metered consumption

This falls under the Consumer Demand Management concept as per the WC/WDM linkage discussed in the literature review chapter. The targets that were set for the increased billed metered consumption as per the BCMM WC/WDM strategy (BCMM, 2013) were not fulfilled, as shown in Table 4 below.

Table 4: Increased billed meter consumption

Target date	Goal	Billed metered consumption (% of total volume supplied)	Goal achieved?
2012-06 (Inception)		49.5%	
2014-06 (2 years)	55%		
2015-06 (3 years)	57.5%		
2017-06 (5 years)	62.5%	45.01%	Goal not achieved

Source: GLS CONSULTING (2019:32)

The following was obtained from the documents:

“BCMM is experiencing problems with the zonal and bulk metering, accurate smaller water supply zone reporting is not possible yet and the non-functionality of bulk meters due to vandalism and interruption of power supply is causing a major negative impact in the municipality with regards to data collection and processing (BCMM Water Supply Services Department, 2019).” (BCMM water audit quarterly 2018/19 report, 2019)

“...illegal water connections have been taken as one of the contributors to unaccounted and unauthorised water consumption (Lobanga, et al., 2019).” (BCMM WSDP, 2019)

The participants felt that the meter installation programme is not effective enough for the reduction of unaccounted water, as the municipality is still struggling even to read the existing water meters:

“...revenue water is the main challenge in the municipality due to the massive fluctuations on the number of accounts that we believed is because of the water meters that are not being read by our billing section.” Respondent 5, BCMM, 2020)

According to McKenzie, et al. (2012), in some part of the country, payment levels are very low and very limited information exists on the unbilled authorised consumption; thus, this has a major impact on the unaccounted water, when comparing input and output volumes in water balance. Although new meter installation projects were reported to be successful, the table indicates the opposite, i.e. decrease in billed metered consumption percentage of a couple of years since the inception of the strategy (GLS Consulting, 2019).

iii) Ability to undertake a detailed water balance

BCMM WSDP (2019) report provided the following statement concerning water balance:

“...the municipality [BCMM] had adopted an International Water Association water balance tool as per the DWS (Lobanga, et al., 2019).”

“...since data obtained from bulk meters is poor, the present data is being estimated to calculate the water balance, thus, in reality, it is deemed that the goals have not been achieved (Lobanga, et al., 2019).”

Table 5 below provides progress on water balance targets, which shows that between 2015 and 2017 financial year, BCMM WC/WDM strategy (BCMM, 2013) the goals were not achieved.

Table 5: BCMM water balance targets

Target date	Goal	Goal achieved?	Comments
2012-06 (Inception)			Water balance only possible on city wide level
2014-06 (2 years)	Per water treatment supply zone	Goal achieved	Water balance per water treatment supply zone is possible, but currently not reported on.
2015-06 (3 years)	Per reservoir supply zone	Goal not achieved	Bulk meters available at reservoir outlets but challenges remain w.r.t. functionality and reading of meters. Water balance currently reported on at reservoir supply zone but based on estimated data
2017-06 (5 years)	Per sub-zone	Goal not achieved	Water balance is currently only reported on a city wide level

Source: GLS CONSULTING (2019:35)

Participants from the water supply department felt that water balancing is not done properly, and one of the participants stated:

“Although I am not directly involved with the water balancing calculation, I feel that it is not done accordingly, as there are still bulk pipelines with faulty or no meters...”
(Respondent 7, BCMM, 2020)

It has been reported that about 44% of municipalities are unable to provide proper water balance; thus, WC/WDM projects that are “identified and implemented are based on

perceptions without proper information on water management such as baseline volume” (Wegelin and Jacobs, 2013:416). Correspondingly, most projects are disappointing and not achieving the WC/WDM strategy objective or goals (Wegelin and Jacobs, 2013).

Concerning pressure management, the following information was obtained:

“Pressure management might be a key strategy in this regard in the future, possibly intrinsically linked with the mains replacement strategy (Lobanga, et al., 2019).” (BCMM WSDP, 2019)

“Pressure management programme has only been added under the water loss intervention programme after the water pipeline mains replacement programme has been completed (GLS Consulting, 2019).” (BCMM WC/WDM review report, 2019)

Most of the pressure management programmes or project have been completed, as shown in Table 6 below. However, there were no financial-savings outcomes reported by the BCMM IDP (2017) review report below:

“...although there has been some progress in pressure management initiatives, there have been no tangible results related to financial savings (BCMM, 2017).”

Table 6: Pressure management progress

Progress report date	Comments	Progress
26/05/2015	Installation of 6 new PRV's in Reeston Area	Investigations on pressure management potential at Reeston have been completed. Installation of PRV's is under way. Expected completion June 2015
04/09/2015	Installation of 6 new PRV's in Reeston Area Further pressure management investigations	4 of 6 PRV's completed in Reeston area Investigations under way on pressure management potential in Cuttings reservoir supply zone in Mdantsane
2015/16 FY	Installation of 6 new PRV's in Reeston Area Refurbishment/replacement of 4 existing PRV's in Reeston	100% complete 98% complete

Source: GLS CONSULTING (2019:28)

Information gathered from the interviews also agrees that no results have been produced yet, as indicated below:

“...also, our leak detection programmes and pressure management are used in minimising the water losses in the municipality, however, no financial-savings results have been yielded so far.” (Respondent 4, BCMM., 2020)

“...bulk metering, zonal metering and pressure management, we are busy with those programmes currently...” (Respondent 10, BCMM, 2020)

According to McKenzie, et al. (2012) and Wegelin and Jacobs (2013), pressure management is regarded as best practice when it comes to WDM. Wegelin and Jacobs (2013) further stated that a reduction in minimum night flow of 15% to 30% could be expected from various pressure management projects

iv) Water use efficiency promotion

Information found in the BCMM IDP review report (2017) stated the following:

“Promotion of water use efficiency targets were met as the implementation of routine school educational and community awareness programmes which started in the 2013/14 financial year were successful (BCMM, 2017).”

Table 7 below show that targets were met in the development and implementation of water use efficiency initiatives and programmes.

Table 7: BCMM promotion of water use efficiency

Target date	Goal	Goal achieved?	Comments
2012-08 (Inception)			
2013-08 (1 year)	Routine community awareness programmes implemented	Goal achieved	Successfully implemented in 2013/14 financial year
2014-08 (2 years)	Routine schools education programmes implemented	Goal achieved	Successfully implemented in 2013/14 financial year
2013-08 (1 year)	Appropriate plumbing by-laws / design standards developed	Goal achieved	Water Services By Laws were approved in March 2011. Design & construction standards for water services are in place

Source: GLS CONSULTING (2019:36)

“However, it should be noted that the success of both community awareness and schools educational programmes were successful based only on compliance (GLS Consulting, 2019).” (BCMM WC/WDM strategy review report, 2019)

Findings from the interview sessions show that the BCMM water department has established small-scale community awareness campaigns known as “water week”, targeting schools and conducting workshops:

“We are conducting an annual educational and community awareness campaign – water week, where we visit schools to conduct workshops on saving water...however,

this has not been yielding results. We need a professional, social facilitator to do this. You know, we are technical people!” (Respondent 4, BCMM, 2020).

According to DWAF (2004b), the water use efficiency is incorporated in the Consumer Demand Management concept. Community awareness and educational campaigns are a vital part of the WC/WDM components as these are successful in contributing to changing or influencing social norms around water usage in the communities (Parks, McLaren, Toumi and Rivett, 2019).

v) WC/WDM Institutional capacity enhancement

“Enhancement of institutional capacity involved the appointment of an official champion, political champion and interdepartmental task team (Lobanga, et al., 2019).” (BCMM WSDP, 2019)

The intended targets as per the strategic objective are yet to be achieved as Table 8 below illustrates progress against goals set in the BCMM WC/WDM strategy.

Table 8: BCMM Institutional capacitation progress

Target date	Goal	Goal achieved?	Comments
2012-06 (Inception)			
2013-06 (1 year)	Adopt WC/WDM Strategy	Goal achieved	Current 2012/13 - 2017/18 strategy adopted in October 2012
2013-06 (1 year)	Budget allocated on 3 year MTEF	Goal achieved	Budgets were successfully allocated. However, allocated budgets in 2012/13 and 2013/14 were less than budgets required as per detailed inception total project budget
2013-06 (1 year)	Political champion appointed	Goal not achieved	WSA plan to implement in 2019/20 financial year
2013-06 (1 year)	Official champion appointed	Goal not achieved	WSA plan to implement in 2019/20 financial year
2013-06 (1 year)	Interdepartmental task team to oversee the implementation and review of the Strategy established	Goal not achieved	WSA plan to implement in 2019/20 financial year

Source: GLS CONSULTING (2019:37)

Although according to the comments from GLS Consulting (2019), stating that implementation was targeted for 2019/2020 financial year, one of the participants mentioned that there were no appointments yet made to discuss this (Respondent 2, BCMM, 2020). Wegelin and Jacobs (2013) stated that many municipalities have limited or no technical, institutional and financial capacity for WC/WDM strategy planning and implementation, failing in fulfilling the WC/WDM strategic goals. According to DWAF (2004f), institutional strengthening and

capacity building are one of the key aspects for effective implementation of WC/WDM in water services institutions.

WATER RESOURCE MANAGEMENT AND RETURN FLOW MANAGEMENT

It has been identified that the established BCMM WC/WDM strategy objectives (BCMM, 2013) excluded the Water Resource Management and Return Flow Management phases incorporated in the national WC/WDM strategy (DWAF, 2004d). Although these phases were excluded from the BCMM WC/WDM strategy (BCMM, 2013), the study established important findings related to these phases, which are identified as follows:

– Water Resource Management

Although the WC/WDM strategy objectives have not incorporated a detailed water quality management, it is considered as a key element in terms of water resource management pertaining to environmental pollution preventions. According to the BCMM WSDP (2019):

“Improving wastewater treatment works performance involves enhancing disinfection system in all BCMM wastewater treatment works, as it has been reported that the overall chemical and microbial qualities of BCMM wastewater treatment plants are poor and bad (Lobanga, et al., 2019).”

However, WSDP has also confirmed the upgrade of wastewater treatment works in Gonubie, Reeston, Schornville and Zwelitsha to improve the level of wastewater treatment and quality.

BCMM WC/WDM strategy has not incorporated management of water resources as most of its dams and rivers are managed and controlled by Amatola water boards and department of water and sanitation (BCMM, 2013), and has been agreed by the majority of participants during the interview sessions.

“...most of the dams that supply BCMM are owned by the Department of Water and Sanitation. The only dam that BCMM owned (Bridle drift) has an active dam inspection report which is updated every five years. This is used as a tool that provides the risk of the dam.” (Respondent 3, BCMM, 2020)

This brings huge concerns as the national WC/WDM strategy (DWAF, 2004d) emphasise on integrated water management approach to achieve an effective WC/WDM implementation (DWS, 2014).

According to Wegelin and Jacobs (2013), water conservation is predominantly applicable in water restriction and drought scenarios, and BCMM has embarked on stage 3 of water

restriction hoping to cut water consumption by 25% due to recent drought occurrence (BCMM Communications Department, 2020).

“A ‘Save Water Awareness Campaign’ was conducted to sensitise communities on the drought conditions, however, due to the ad-hoc approach in its coordination and implementation, it was not possible to take advantage of this drought campaign, which was widely publicised locally (BCMM, 2020).” (BCMM Communications Department, 2020)

The emphasis was also on needed proper and effective planning when it comes to WC/WDM measures, including the development of risks assessments, and one of the participants highlighted the following:

“There are more than twenty-seven drought indicators, and we need to use those indicators so that we are a bit clear to where water shortages and shortfalls are going to be...but also we need to build in the drought indicators...the drought we managed [as BCMM] has been coming more than four years, but we’ve only implemented water restriction when water was sitting under 60% capacity. It is too late to then start water conservation measures. Your water conservation measures need to be informed by drought indicators.” (Respondent 1, BCMM, 2020)

– **Return Flow Management**

It also has been reported that the WC/WDM strategy does not include the Water Re-use concept as it is addressed as a stand-alone BCMM Water Re-use strategy, which incorporates the possible reuse of effluent (return flow) from the wastewater treatment works (BCMM, 2013). A participant on a management level confirmed that BCMM is developing a water reuse strategy to assist with the requirement of water optimising the recycling of greywater and reduction of pollution caused by effluent:

“We are generally doing indirect water reuse on a small scale as some of our wastewater treatment works are already discharging in either a dam or a river upstream the dam.” (Respondent 2, BCMM, 2020)

Although Lobanga, et al. (2019) suggested that water reuse can be a beneficial use for industrial and agricultural processes, there is little information on the documents or reports showing development and implementation of water reuse strategies. The feedback from the interviews related to water-reuse suggested that this is still on a planning phase:

“We are about to investigate the feasible options of augmenting the current supplies through Water reuse, groundwater exploration and desalination; the objective is to

integrate these with the existing surface water schemes.” (Respondent 2, BCMM, 2020)

4.4 RESEARCH OBJECTIVE 3

Identification of constraints and/or opportunities with regards to WC/WDM and make recommendations for improved practices at BCMM

Constraints related to the implementation of WC/WDM strategy have been highlighted under the literature review chapter. In this chapter, key findings related to the study objective will be discussed as they relate to the interviews and document analyses. The findings discussed in this chapter will provide a link with Chapter 5, where recommendations will be provided with regards to the effective implementation of the BCMM WC/WDM strategic goals.

4.4.1 Findings and discussions for Research Objective 3

The issue of funding was discussed during the interview, where the participants acknowledged that the strategy can be effective if more budget can be allocated to specifically its implementation:

“This is a good strategy, which required to be funded correctly, and that will bear success on the water loss minimisation and enhancement of revenue. The expediting of de-densification plans of informal settlements needs to be prioritised.” (Respondent 3, BCMM, 2020)

Another participant also alluded on this financial issue with this comment:

“Our WC/WDM strategy was approved in October 2012, but we only managed to implement it in the 2014/15 financial year due to unavailability of budgets.” (Respondent 1, BCMM, 2020)

The BCMM IDP (2017) report has also highlighted that there are significant constraints affecting the implementation of WC/WDM strategy as stated in the following:

“...limited available water resources and financial constraints on both capital and revenue are hindering the WC/WDM initiatives from being implemented (BCMM, 2016).”

“Budget allocation within specific financial years has been erratic and do not allow for systematic planning of WDM projects (GLS Consulting, 2019).” (BCMM WC/WDM strategy review report, 2019)

According to Wegelin and Jacobs (2013), most municipalities do not have the institutional capacity and financial support for such a strategy.

A strategy needs to be continuously reviewed to ensure that key objectives and goals are still pursued and focused upon. Continuous and routine measures, monitoring and progress reviews with regards to achieving set goals are significant to ensure such mission and vision are achieved (Wegelin and Jacobs, 2013). Therefore, municipalities should ensure that all the collected information provides feedback to the Department of Water and Sanitation as per the regulatory framework (Wegelin and Jacobs, 2013). However, as per the BCMM Water Services Development Plan report, the strategy has been reviewed once (in 2019) since its inception (Lobanga, et al., 2019). The impact of poor communication can make employees feel disconnected without any clear direction from the management, leading to very low engagement, satisfaction, interest and performance (Wells, 2017). Furthermore, at the departmental level, silos keep the teams from effectively working together, leading to low performance as there is no clear vision. A participant from one of the supporting departments made the following comment concerning the communication issues:

“Let me say this to you before we go to the questions. I was not even aware that we have this strategy in Buffalo City...” (Respondent 1, BCMM, 2020)

This shows a lack of communicating and engaging the strategy to the relevant stakeholders as the participant from the water supply department also highlighted the gap with regards to communicating the strategy:

“...also, the filtering down of information is not adequate in my view, because you will find out that people who are doing the actual work on the ground...do that because they are told so or instructed. They do not know the bigger picture of what the municipality is planning. I think the more information we get, the more we will feel that we are part of the solution” (Respondent 11, BCMM, 2020)

Organisations need to implement and maintain effective interdepartmental communication in order to succeed in business, and lack of proper communication systems and internal coherence amongst various departments is one of the major reasons for organisation failure (Gondal and Shahbaz, 2012). Gondal and Shahbaz (2012) further stated that breakdown in interdepartmental communication could impact the organisation efficiency and intensify stress level on employees, which can ultimately result in poor performance.

4.5 CONSOLIDATION OF SOME KEY ALIGNMENT CONCERNS AND CHALLENGES EMERGED FROM THE FINDINGS

The study identified some key alignment concerns, gaps and challenges related to national WC/WDM strategy (DWAF, 2004d), and WC/WDM guidelines (DWAF, 2004f). These are consolidated and discussed henceforth.

4.5.1 Stakeholder engagement

BCMM need to identify its key stakeholders related to the establishment of its WC/WDM strategy. As per the national WC/WDM strategy requirement (DWAF, 2004d), the stakeholder engagement process is not part of the BCMM WC/WDM strategic key objectives (see Section 4.2.1 findings). These findings related to the stakeholder process include stakeholder identification, register/database, roles and responsibilities. This is a concern for BCMM in terms of effectively implementing its WC/WDM, as the BCMM WSDP (2019) stated:

“...stakeholder engagement is a key component of developing an effective and implementable strategy, as these types of engagements provide a platform for stakeholders to influence the decision-making process and creates awareness of the project and its objectives (Lobanga, et al, 2019).”

Literature has highlighted that stakeholder engagement can be used interchangeably with stakeholder management when describing communication and interaction processes with affected stakeholders (Water Research Commission, 2014). Meanwhile, Luoma-aho (2015) has viewed stakeholder engagement as a core in ensuring that relationship between the organisation and public is positively sustainable. This is relevant to BCMM in ensuring good relations with all affected stakeholders.

When developing a strategy and establishing policies, stakeholder participation is vital (Mzimakwe, 2010), thus there is a need for BCMM to ensure stakeholder participation in its WC/WDM strategy. Contrary to this, a lack of participation from various stakeholders or poor process facilitation creates a sense of being excluded from the processes involved (Pacione, 2014). BCMM, in this case, must ensure proper coordination and engagement of stakeholders in the process of developing and implementing the WC/WDM strategy.

4.5.2 Communication

One of the challenges or constraints experienced by BCMM with regards to the effective implementation of the WC/WDM strategy is the lack of communication (as per Section 4.4.1). This section is also interlinked with the previous section (4.5.1) as it deals with the communication of all involved stakeholder, internally and externally. Issues related to

communication, coordination and support from every affected stakeholder in any environment will always bring hindrances to progress. An important topic of concern and interest, especially in the government or public sphere is the organisation fragmentation (Maggioni, 2015). This is relevant to BCMM, as one of the interviewees stated:

“The [BCMM] WC/WDM strategy is not communicated well, as our departments are working in silos...there is no interaction between the engineering department and billing [department], which also frustrated the customers – I think.” (Respondent 5, BCMM, 2020)

The literature supports the above statement, as Wegelin and Jacobs (2013) specified that one of the current constraints is that finance and technical departments are working in silos instead of supporting each other in resolving billing and metering faults.

Communication is the most important in ensuring that both parties have understood the message during the process of exchanging any opinions, ideas or information (Hacker, 2003). BCMM has to ensure that all the relevant people and organisation involved in the BCMM WC/WDM strategy need to be in the same level of understanding as to ensure the mentioned WC/WDM strategy goals are fulfilled. Hacker (2003) further provided key communication process elements such as channelling, messaging, receiving and feedback, which BCMM can explore when preparing a communication plan.

The literature recommends that administrators or organisations should have active listening skills and be aware of the significant responsibilities of both the sender and receiver, therefore, creating an environment where issues or plans or thoughts or opinions are professionally handled through effective and positive communication (Adu-Oppong and Agyin-Birikorang, 2014). The recommendation is relevant to BCMM as the WC/WDM strategy administrator.

4.5.3 Escalating non-revenue water and water balance

As it is a national requirement, reduction of non-revenue water is one of the key WC/WDM strategy objectives (DWS, 2014), and as previously discussed and from the findings, BCMM is still struggling in reducing non-revenue as per its strategic targets: see Section 4.3.1 (i). This is not unique to BCMM and various municipalities are struggling with reducing non-revenue water (Wegelin and McKenzie, 2013). According to Simbeye (2010), there are various ways that cause high non-revenue water, such as poor infrastructure quality, poor or no metering and high unauthorised water use. Most of these identified causes are relevant to BCMM as per findings in Section 4.3.1.

Intervention measures on reducing non-revenue water highlighted by the literature include the following (Simbeye, 2010):

- Installation of bulk meters and zonal meters in reservoirs, water treatment works.
- Identify water leaks, report and repairs leaks.
- Development and implementation of pipe replacement projects.
- Undertake internal plumbing retrofitting and implement projects related to retrofitting.

This is also supported by Kamani, Malakootian, Hoseini and Jaafari (2012) when they stated in a case study that it was found that the main contributor to non-revenue water is real losses which can be reduced by repair and replacement of leaking water network and meters. BCMM needs to undertake these measures in an effective manner and through proper monitoring, as the study has identified that the mentioned interventions have already been implemented as per findings under Research Objective 2.

As discussed in the literature review chapter and findings in 4.3.1(iii), it has been identified that water balancing is still a challenge in BCMM. This is not only experienced in BCMM as literature confirms that about 44% of municipalities in South Africa are still unable to formulate proper water balance (Wegelin and Jacobs, 2013).

4.5.4 Billed meter consumption

Findings related to billed meter consumption have been highlighted in Section 4.3.1 (ii). As highlighted by the findings, there are some discrepancies when it comes to metering and unauthorised water use. The misalignment of information related to available domestic meters contributes to the ineffectiveness to fulfil the BCMM WC/WDM strategy objective mentioned in Section 4.3. The BCMM WC/WDM review report (2019) highlighted the following key concerns:

“District Engineers reported that almost every household in BCMM is metered, but meters are not necessarily read. Meanwhile, the head office water supply services staff reported 6000 to 1000 households are not metered, however, according to the treasury database, approximately 16900 households are billed on flat-rate and not meters (GLS Consulting, 2019).”

“Lack of proper meter reading (as most meters are reported covered); inability to access meters (meters are inside the yards); Limited staff to maintain the existing meters; discrepancies between Finance billing database and Engineering meter database; and external political interference in the installation of meters are other key concerns raised (GLS Consulting, 2019).”

The literature highlights the need to provide necessary solutions to these challenges and concerns. This is supported by Rabe, et al. (2012), when he stated that the need for demand-side interventions that effectively reduce physical losses in water networks, as well as apparent losses due to metering and billing deficiencies, is abundantly clear. BCMM WC/WDM strategy goals are directly affected by inaccurate, inadequate billed meter consumption. International literature on best practices effective metering includes programmes such as meter replacement, meter installation, and maintenance (calibration) of existing meters (Environmental Protection Agency, 2016). The study identified that BCMM has these programmes as per Research Objective 2; however, there is no consistency in implementation.

4.5.5 Pressure management

This is linking with the findings in Section 4.3.1 (iii). According to the BCMM WSDP (2019), BCMM the following was adopted concerning physical water loss reduction:

“Mains replacement: focusing on the replacement of AC pipes, and Pressure management in areas with high pressure. (Lobanga, et al., 2019).”

Although pressure management has not been part of the key BCMM WC/WDM strategy objectives (BCMM, 2013), it is a key component in WC/WDM, as the literature support this statement henceforth. Pressure management is one of the key components of WC/WDM (Kampragou, Lekkas and Assimacopoulos, 2010), and from the results provided by the BCMM WC/WDM review report (2019), it shows that pressure management projects were established and implemented, although, they were not very effective (as stated in Section 4.3.1).

It has been highlighted by Mckenzie (2014) under the literature review that replacement of water pipelines is vital when the pipes have deteriorated such that there are consistent high leaks due to high pressures. The Environmental Protection Agency (2016) also stated that pressure management is the best practice in controlling water leakage on water systems. Wegelin and Mckenzie (2002) conducted eight pressure management pilot studies in South African townships (including BCMM’s Mdantsane township), where they identified that pressure management is an effective measure with regards to WDM. BCMM needs to ensure that the pressure management is properly implemented, controlled and monitored in a consistent manner.

4.5.6 Promotion of water efficiency programmes

This has been identified in Section 4.3.1 (iv) as one of the key findings. BCMM Awareness progress report (2020) stated the progress and challenges encountered with implementation of water efficiency initiatives, as follows:

“The current worldwide pandemic of Corona Virus (COVID 19) has thrown a new challenge to the planned Awareness Campaign for schools and other targeted communities (BCMM, 2020).”

“... a Save Water Awareness Campaign was conducted to sensitize communities on drought conditions. However, due to the ad-hoc approach in its coordination and implementation, it was not possible to take advantage of this drought campaign - which was widely publicised (BCMM, 2020).”

Respondent 4 (BCMM, 2020) during the interview session stated that educational initiatives and community awareness programmes were not conducted effectively in BCMM, as there is no social facilitation personnel/expert for such duties.

Rabe, et al. (2012) stated that initiative aimed at modifying the behaviour of water end-user should be included in the programmatic approaches to WC/WDM, as this is more critical in the national context concerning to future water scarcity. Bryx and Bromberg (2009) highlighted linkage between water efficiency use and educational and public/community awareness initiatives, when they stated that educational and public awareness forms an important part of WDM since they have a potential to alter water-user behaviour on saving water. The literature further stated that engagement of the public, as a vital partner and key stakeholder with regards to water-saving projects, is conceded as one of the best practices initiatives (Bryx and Bromberg, 2009). Brynx and Bromberg (2009) then recommend that implementation of educational awareness programmes to change patterns of water consumption should involve communities, schools, businesses, media platforms (radio, televisions, newspapers) and self-assessment water audit kits. BCMM needs to incorporate and implement these water efficiency initiatives.

4.5.7 Institutional capacitation

The strategic objectives related to the enhancement of institutional capacitation remain unachieved, as per the findings in Section 4.3.1 (v). The BCMM WSDP (2019) stated the need to capacitate BCMM human resources and challenges face by the municipality, as follows:

“In order for BCMM to fulfil its water supply and sanitation mandate, human resources such as skilled technical personnel are required, and it was found that the municipality is inadequately staffed (Lobanga, et al., 2019).”

Literature highlights the negative impact of incapacitated institutes when dealing with WC/WDM establishment and implementation. This is indicated by Wegelin and Jacobs (2013) when they stated that many municipalities do not have the institutional, financial and technical

capacity to support their WC/WDM strategies, and the existing strategies are ambiguous. As per the findings, this is relevant to the BCMM's current situation. Lack of institutional capacity, funding and technical skills for managing, operating and maintaining water infrastructure is the result of failure to provide reliable water services in some municipalities (Viljoen and Van der Walt, 2018). BCMM is not immune to these challenges as highlighted in this study (see Research Objective 3 discussions). According to Viljoen and Van der Walt (2018), the action that needs to be taken with regards to institutional capacity involves establishing regulations on technical and senior positions' experience and qualifications in municipal water services departments. DWAF (2004f) specified that training programmes for key personnel should be established and implemented to ensure adequate institutional capacity, and also define career path with defined training and on-the-job experience to build professionalism (Viljoen and Van der Walt, 2018).

4.5.8 Financial support

As per the findings in Section 4.4.1, lack of budget or financial support is one of the major constraints when it comes to the implementation of WC/WDM measures. According to the BCMM WSDP (2019), BCMM is monetarily constrained with regards to the implementation of water projects:

“The funding allocation shortfall for the projects including direct and indirect impacts to implementation of WC/WDM projects were identified in the Mid-Term Expenditure Framework (Lobanga, et al., 2019).”

Funding has been highlighted as the challenge to the implementation of the strategy. According to Wegelin and Jacobs (2013), financial capacity in municipalities is needed in order to implement the WC/WDM strategy successfully. It has been established that the implementation of WDM measures is expensive and not quick, and most metropolitan municipalities have not been given adequate attention or budget (Wegelin and McKenzie, 2013). Limited financial availability in all the government levels seems to make even simple projects and programmes unaffordable (Ruiters, 2013).

According to Ruiters (2013), due to ever-increasing cost of water infrastructure, South Africa has to look for innovative methods as to ensure there are reduction of water backlogs, thus, new models of funding are needed to enhance the current funding systems. Ruiters (2013) described the existing and new water infrastructure models, as following:

- **National Revenue Fund:** Primary responsibility of DWS to allocate budget for infrastructure development. (*existing model*)

- **Balance Sheet Funding** (Tariff Model): charges for water usage by water service institutions. (*existing model*)
- **Raising funds on financial markets:** Commercial bank lending; corporate bonds; institutional investor (such as Public Investment Corporation); and stock exchange issues. (*new model*)
- **Financial Institutions:** Financial institutions such as DBSA are mandated to finance water infrastructure projects. (*new model*)
- **Public-private partnership Funding (PPPs):** there are few PPPs used for water infrastructure programmes, such as lease-contract in Lukanji Municipality and operating contract in uThungulu District Municipality, to name few.

Therefore, BCMM needs to explore these available water infrastructure models to motivate for grants to support its WC/WDM strategy.

4.6 CONCLUSION

The chapter provided qualitative data collection, findings and analysis of the study in BCMM, with the aim of achieving the main objectives of the study as indicated in chapter 1. Current BCMM WC/WDM strategy has been introduced and a summarised layout has been provided, with focus to key information, incorporating findings, discussions through interview sessions with selected participants and results.

Although BCMM has developed and implemented its WC/WDM strategy, there are major concerns raised in this chapter which need to be dealt with. Also, some improvement is necessary as to ensure effectiveness of the BCMM WC/WDM strategy, as to yield positive results or outcomes. Thus, this chapter links the recommendations provided in the following chapter. Due to broader scope of WC/WDM and limitation of this study, the interviews could not cover all the related aspects.

CHAPTER 5: RECOMMENDATIONS AND CONCLUSION

Findings and results from the discussions and review of relevant documents are combined to highlight and understand how the various aspects talk to each other in order to provide possible recommendations.

Recommendation 1: Stakeholder engagement

Although stakeholder engagement is not new, it has been accepted as a fundamental part in the success and sustainability of an organisation; therefore, understanding between good or bad engagement quality is significant (Gruninger, Baue, Canassa and Kim, 2015). Gruninger, et al. (2015) further stated that the integration of stakeholder engagement into operations, governance and strategy of an organisation requires a systematic and regular use of the stakeholder engagement across the organisation. Same needs to be applied to BCMM. Figure 2 below show four stages of stakeholder engagement. Wegelin and Jacobs (2013) recommend that institutional arrangement is required to achieve WC/WDM strategy goals (talk to the diagram and link to a finding).



Source: Gruninger, et al. (2015)

Figure 2: Stakeholder engagement process

As per Figure 2, the necessary step that needs to be taken in the stakeholder engagement process are (Gruninger, et al., 2015):

- **Plan:**

This step includes providing a stakeholder profile and a map. This should be considered in engagement planning and implementation. The organisations should determine engagement levels and methods with stakeholders, including creating communication boundaries. Then a draft engagement plan should be created and engagement indicators formed.

– **Prepare:**

An organisation should mobilise the resources required in the engagement process. In terms of building capacity, the organisation should identify together with the stakeholders if a capacity to engagement needs to be built. There is also a necessity to identify and prepare an engagement risk plan.

– **Implement:**

The organisation should then invite stakeholder to participate – the communication must be done well in advance to allow stakeholders to prepare in time. The organisation should brief the stakeholders prior to engagement. Then, engagement and outputs should be documented, to draft an action plan.

– **Act, review and improve:**

In this step, it is vital to monitor and evaluate the engagement, in order to learn and improve. The organisation should establish a follow-up on the action plan. And, finally, the engagement should be reported to the relevant stakeholders.

These steps are necessary for BCMM in improving its stakeholder engagement process. In order for BCMM to effectively communicate the strategy, it needs to understand and identify its key stakeholders that are involved in the development and implementation of the BCMM WC/WDM strategy. BCMM should establish communication of the strategy in a language that can be understood by each stakeholder. BCMM should also ensure that all the stakeholders are engaged from the onset to attain accurate status quo reflection and any forthcoming development goals related to the BCMM WC/WDM. A precise plan entailing stakeholder register list and responsibilities should be established.

Recommendation 2: Communication

Issues related to communication, coordination and support from every affected stakeholder in any environment will always bring hindrances to progress. An important topic of concern and interest, especially in the government or public sphere, is the organisation fragmentation (Maggioni, 2015). This links to findings in Section 4.4.1 and literature discussed in Section 4.5.2, where study identified gaps concerning communication. Thus, as per the mentioned discussions, BCMM should establish a proper communication plan and use appropriate modes and devices of communication such as media platform.

Recommendation 3: Reduction of non-revenue water and detailed water balance

According to BCMM WC/WDM review report (2019), there are two areas identified as major contributors to the increase in non-revenue water and these areas are supplied by Amatole bulk water supply system. The recommendations of the water loss investigation reports included the

following implementation projects for the two areas, respectively: Installation of zonal meters, replacement of faulty meters and valves.

As per Section 4.5.3 literature and discussions, in order to obtain an effective reduction of non-revenue water, BCMM needs to assess supply zone or areas where the non-revenue percentage is high. Installation of bulk meters, including verification and calibration of the existing meters, should be prioritised, as to perform a detailed and proper water balance. BCMM management should continuously communicate with Amatole District municipality to verify the functionality of meters in the Amatole bulk supply system, as this will assist in obtaining accurate data or information. BCMM technical staff must ensure the operation and maintenance of all the meters. Also, staff that have the duty of providing information and formulating water balancing in BCMM needs to be properly equipped and provided water balancing related training.

Recommendation 4: Billed meter consumption

It has been found that one of the major problems adding to the ever-increasing unaccounted water in BCMM is the lack of consumer water metering. Environmental Protection Agency (2016) stated that proper following of metering related programs and policies enables water services providers to evaluate water consumption savings and also are able to control projected water demands to account for lower water consumption expected of billed meters consumers. Most middle/lower income township areas in BCMM are flat-rated, and Environmental Protection Agency (2016) emphasised that no consumer should be billed a flat-charge of any kind as the total way of billing, thus, this exercise is not regarded as best practice. As per the audit report, about 16 900 households were not metered and were billed on flat rates (GLS Consulting, 2019).

As per the discussions in Section 4.5.4, BCMM should identify areas that are flat-rated and implement domestic meter installation programmes or projects. BCMM also needs to take advantage of technology innovation through the development and implementation of smart metering, which will assist the billing department with accurate meter reading data. Pilot projects with regards to smart-metering needs to be implemented and closely monitored to a specific area before they can be implemented to the entire BCMM. BCMM water supply services should work closely with the billing department to ensure smooth transmission of any technical information related to meter installation and monitoring, as to provide accurate information to the water users for billing purposes.

Recommendation 5: Pressure Management

There are various benefits of pressure management, such as reducing water pressure throughout the water supply system, overall water consumption reduction, water loss reduction through leaks thus resulting in reduced pipe burst frequency and further water leaks (Parks, et al., 2019). According to the BCMM WDC/WDM review report (2019):

“it is highly recommended that preference is to be given to investigations into further pressure management projects due to the significant immediate effect that pressure management can have at a relatively low cost/benefit ratio (GLS Consulting, 2019).”

Recommendation to the municipality is to identify areas with high pressures through hydraulic modelling and install pressure-relief valves where necessary. BCMM should ensure proper monitoring and maintenances of the existing and newly installed pressure-relief valves. As per the literature and discussions stated in Section 4.5.5, replacement of leaking pipelines due to high pressure should be prioritised by BCMM and project related to this WC/WDM intervention should be implemented with urgency. Also, in a case study (eight pilot studies) conducted through eight townships, including Mdantsane (BCMM township) in South Africa (Wegelin and McKenzie, 2002), the authors emphasised that clear pressure management is a very effective measure with regards to WDM.

Recommendation 6: Promotion of water efficiency programmes

Participants from the water supply department stated during the interview sessions that a small-scale educational and community awareness programme, commonly known as “Water Week” (BCMM, 2020), has been implemented within the water section. As per the BCMM WC/WDM strategy review report (2019), the Water Week programme included the following:

“Centralised stall setup in Malls, where customers are given the opportunity to ask questions related to water savings or report water leaks. The reports are then given to the water supply department for a followup. Investigations to various schools with high water consumption are conducted, where also the technicians also made visits to educate pupils about the importance of saving water. Banners, flyers and brochures containing water-saving information are provided from the stalls and schools.” (GLS Consulting, 2019)

Although the Water Week (BCMM, 2020) is done on annual basis, it has been reported by the participants as not effective enough due to the fact that it is driven by technical people who have no expertise on the social-related campaign. According to Bryx and Bromberg (2009), due to the potential to change behaviour on a massive scale to saving of water, public and educational awarenesses are considered to be the water demand management integral aspects. Furthermore, they also stated that the engagement of the public as partners and key stakeholders in water-saving projects is regarded as the best practice initiative. As per the discussion and supporting literature in Section 4.5.6, BCMM should emphasise the importance of quick response to leak reports by ensuring that there are available plumbers dedicated to the mentioned programmes. Other media such as local radio stations, television and social media platforms should be explored and sharing information on water savings.

Recommendation 7: Enhancement of Institutional Capacity

This links with the discussion in Section 4.5.7, where challenges and gaps associated with institutional capacity were explored. It was surprising that during the interview session some of the participants never realised that there is a documented dealing with WC/WDM aspects, although most of the duties and daily activities speaks to the strategy itself. This means there is no clear and structured team that is focused on overseeing, coordinating, control and managing the strategy implementation. It also has been informed that there are vacant unfunded posts under the BCMM water services section, which make it difficult for the current Water Services programme manager to make any progressive effort in the implementation of the strategy (Respondent 2, BCMM, 2020).

The following should be implemented in enhancing institutional capacity as per the BCMM WSDP (2019)

“Appointment of a political champion as per the requirement of the strategy; Decision-makers such as senior or executive management and political structure must be trained and sensitised about the importance and need of the WC/WDM; Relevant policies and by-laws must be adopted and implemented by the responsible personnel; Skilled personnel needs to be recruited; meanwhile, various training should be provided for the existing staff; Critical positions need to be filled and prioritised; There is a need for an appointment of the official champion as per the requirement of the strategy and establishment of the interdepartmental task team overseeing the strategy implementation and review is vital (Lobanga, et al., 2019).”

Under the BCMM political executive council, there is a portfolio councillor for the infrastructure department (BCMM, 2016) which can be utilised as the political champion for

the BCMM WC/WDM strategy. This political champion should act as a linkage between the political executive council and the administration side to ensure smooth communication and mutual understanding with regards to the BCMM WC/WDM strategy. As per the requirement of the BCMM WC/WDM strategy review report (2019), BCMM should establish an interdepartmental task team that will assist in ensuring proper communication and engagement of various stakeholders with regards to the implementation of the WC/WDM strategy.

Filling of critical vacant posts in the technical department as per the findings in Section 4.2.1 (c) should be prioritised by BCMM to ensure that implementation of WC/WDM programmes or initiatives are performed by qualified staff. Also, recommendation highlighted in Section 4.5.7, BCMM should “establish regulations on the qualifications and experience of senior and technical positions” (Viljoen and Van der Walt, 2018). BCMM should also provide training programmes for its key staff who are involved in the establishment and implementation of WC/WDM strategy (as supported by literature in Section 4.5.7).

Recommendation 8: Financial Support

Wegelin and Jacobs (2013:416) recommend “budgeting smaller amounts that are within the means of the municipality or grant funding to be targeted once a proper business plan can be developed within the means of the municipality”. The limited budget in implementing of such programme in municipalities is always a common problem or constraint, however seeking sponsorship or partnership from other businesses or organisations is feasible, and in light of this, Conward Consulting (2007) suggested that considering the impending water crisis in South Africa, the Development Bank of South Africa (DBSA) has committed itself in providing support to water resources protection programmes or initiatives. Therefore, since the successful implementation of the WC/WDM strategy is one of the essential processes in securing a sustainable water supply in this country, many local water supply authorities have been funded by DBSA in implementing WDM projects (Conward Consulting, 2007).

As discussed in Section 4.5.8, there is a number of funding models in South Africa, which BCMM can explore in order to obtain a supporting grant that will enable the municipality to implement its WC/WDM strategy. These funding models include Financial Institutions, National Revenue Fund, Public-private Partnership Fund and raising funds on Financial Markets. According to Ruiters (2013), organisations should prepare a proper and well-aligned business plan when applying or requesting the mentioned funds. This also applies to BCMM, as a water service institute mandated to implement WC/WDM related projects.

Recommendation 9: Review of the WC/WDM Strategy

Wegelin and Jacobs (2013) have continuously emphasised on the importance of routine monitoring and review of WC/WDM strategies, to ensure that goals achieved through a continuous process of “plan, do, check and act”. Although the strategy itself suggest a routine annual review, however, it has been reported and confirmed that the strategy had been reviewed once since its inception. Lobanga, et al. (2019) recommended that continuous assessment and review of the strategy should be prioritised to ensure that its objectives are prioritised and monitored. Considerations should also be a balance between the WC and WDM aspects in order to bring a holistic, integrated approach, as the strategy is more focused on WDM measure and ignoring the other part. Going forward, BCMM needs to review the WC/WDM strategy annually, as per the basic national WC/WDM strategy requirement. Each BCMM WC/WDM strategy objective discussed under Research Objective 2 should be carefully considered and evaluated to highlight key implementation challenges and gaps, in order to provide practical solutions. The established BCMM WC/WDM steering committee should ensure that this process is carefully followed.

Recommendation 10: Explore other alternative water supply sources

Even if desalination is still considered as an expensive exercise, which requires appropriate research and development, BCMM should consider and use such opportunity as an alternative option in increasing water supply sources, as there is scarcity of freshwater. Hedden and Cilliers (2014) suggested that there is enormous potential and opportunity to industrial and municipality water reuse for both inland and coastal systems, thus it important for BCMM to fast-track the development and implementation of its water reuse strategy. BCMM water supply system is supplemented mostly by surface water which is already constrained due to the recent drought, which also affected the whole country and caused drastic drops of many of the major dam levels. Investigation and feasibility report needs to be developed with regards to groundwater sources with BCMM for alternative water supply.

PROPOSED FURTHER RESEARCH

The study recognises that the scope of water conservation and water management is broad and vast. Therefore, it advised that more detailed research of other WC/WDM aspects in BCMM should be explored more. Further research on water reuse strategy is proposed as it is not covered in the BCMM WC/WDM strategy, including the investigation of the feasibility of alternative water sources such as groundwater and rainwater harvesting aspects. Further research on groundwater might incorporate information of available aquifers with BCMM and determining quality and quantity of water available. Also, it has been highlighted that water

treatment back-wash recycling is one of the water conservation method used, and according to Song, Fan, Zhang, Wang and Feng (2001) the amount of filter back-wash water covers almost 3% of the total treated water production in a conventional water treatment plant process. However, it is possible to recycle the back-wash water directly to the inlet for direct process of filtration, as the back-wash water is generally recycled to the water source for retreatment (Song, et al., 2001). Therefore, BCMM should consider this process of recovering back-wash water in their water treatment plants as part of water conservation.

CONCLUSION

The main purpose of this study was to assess and review the WC/WDM strategy of BCMM with regards to development and implementation and also to identify if there were any opportunities and constraints in the implementation process. Furthermore, recommendations and areas of improvements were discussed.

The BCMM WC/WDM strategy (BCMM, 2013) is a living and practical concept or document, which can yield positive outcomes if implemented effectively, thus routine monitoring of every part of the strategy is significant. Although there are still gaps within the implementation of the BCMM WC/WDM strategy (BCMM, 2013) including the goals or targets that were not met, the positive outcomes from the implementation of water loss intervention activities which effectively provided a reduction in NRW shows the significance of water conservation and water demand practices in the municipality. The strategy can also play a vital role in stabilising water demand growth, regardless of rapid urban and population growth; thus, the WC/WDM is a long-term sustainable concept, which also needs a strategic approach, planning and programmes that have future objectives or goals. Therefore, this should be instilled in every stakeholder involved in the process.

The strategy seems to be focused only on water demand management measures or components, meanwhile “ignoring” the important part of water conservation brings concern, especially as the entire world is experiencing depleting water resources. Water resource management is important in WC/WDM, especially as BCMM is also controlling and operating water sources such as the Bridledrift dam, Maden dam and other groundwater sources within the boundaries of the municipality.

The success of WC/WDM strategy depends on the effective implementation of all relevant, comprehensive policies through the institutional support (incorporating all the stakeholder involvement and buy-in), the formation of a well-established internal structure dedicated to overseeing and managing the WD/WDM with its own budget and capacitated management and staff.

As the NRBV underpinning theory highlights the comparative advantage of organisations, BCMM needs to implement the recommendation, which will improve water management and related resources, comparative advantage (such as natural water resources, socio-economic resources and infrastructure). This will also ensure sustainable WC/WDM that will benefit the present and future generations.

In conclusion, with all the strategy alignment concerns, implementation challenges and gaps raised, the study also acknowledges the foundation laid by BCMM in establishing and implementing its WC/WDM strategy. Also, the efforts taken by the municipality in ensuring that practical WC/WDM measures and intervention are implemented, to ensure sustainable water supply for the communities for the present and future generation.

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APPENDICES

Appendix A – Interview Questions

RESEARCH PROJECT TITLE: Water Conservation and Water Demand Management in Buffalo City Metropolitan Municipality (BCMM)

The aim of the interview questions is to gather more information which will supplement the qualitative data information taken from the documents. Please note that the questions are not in sequences; however, they will be applied as the conversation-opening questions to develop more supplementary questions for the interviews.

The question will be asked at the strategic level through the participation of programme managers and managers, at a tactical level using engineers and senior technicians and at an operational level using technicians as participants. Participants will be selected from three departments that are key role players in the development and implementation of BCMM WC/WDM Strategy.

1. WATER CONSERVATION AND WATER DEMAND MANAGEMENT (WC/WDM) ASPECTS
 - i. What is your understanding of water conservation and water demand management (WC/WDM)?
 - ii. As South Africa is currently facing a freshwater crisis, how would you ensure that BCMM does not overutilize and constrains its natural water sources?
 - iii. How have you prepared for the future to cater for the ever-growing population and development (as one of the major threats) within BCMM in terms of managing and conserving water as a resource?
 - iv. What are your environmental considerations and obligations, as is it predicted that there will be a need for more water supply throughout the country?
 - v. Can you define the level of your development, distribution and management of your water resources in ensuring that there is effective & efficiently use of these water resources in balancing the needs of consumers and eliminating negative environmental impacts?
 - vi. Are there any challenges, opportunities or/and successes you have encountered during the development, distribution and management of your water resources?
 - vii. What was your approach in developing your integration water resources management (i.e. taking into account the natural hydrological cycle, water users/stakeholders, spatial water distribution & usage, and the availability and demand of water resources)?
 - viii. With regards to water conservation, how have you planned in ensuring that there is a reduction or elimination of water wastage and losses within your system?
 - ix. Provide/describe programs or plans that you have to ensure that you encourage the culture of saving water in people or communities at large?
 - x. How would you ensure that environmental & water resources (such as dams) protection are prioritised and are there any contingency plans for natural disasters such as droughts or floods?
 - xi. How well are you prepared with regards to water re-use strategy?
 - xii. How is your unaccounted and non-revenue water?
 - xiii. What plans do you have in ensuring that there is a reduction in unaccounted and non-revenue water?
 - xiv. What intervention measures have you incorporated on your WC/WDM for improvement?

- xv. In ensuring that people are being conservative in their water usage, how would you improve your billing system?
- xvi. What current constraints would you identify when it comes to the application of water conservation and water demand management?

2. UNDERSTANDING OF BCMM WATER CONSERVATION AND WATER DEMAND MANAGEMENT STRATEGY

- i. BCMM has developed a Water Conservation and Water Demand Management (WC/WDM) strategy; in your own understanding can you describe what the strategy is all about and what is its main purpose?
- ii. Can you identify and elaborate any linkages and alignments between the BCMM WC/WDM strategy, BCMM policies and the WC/WDM national strategy?
- iii. What important consideration do you think BCMM needs to apply in order to implement the strategy successfully?
- iv. How would you evaluate BCMM's present performance and progress towards fulfilling the WC/WDM strategic goals?
- v. How would you ensure that the strategic goals are achieved within the specified timeline?
- vi. What needs to be improved to ensure that there is an effective and efficient implementation of the WC/WDM strategy?

3. ROLE AND RESPONSIBILITIES

- i. As your department is one of the committee members overseeing the development and implementation of the WC/WDM strategy, tell me about the key roles your department is/would be performing towards the strategy.
- ii. What important consideration do you think your department needs to apply in order for the whole BCMM implement the strategy successfully?
- iii. Can you discuss or elaborate coordination or linkages of your Water Services Development and Master Planning with the WC/WDM strategy?

4. GENERAL TECHNICAL and THEORETICAL ALIGNED QUESTIONS

- i. Provides any plans in place in your department or BCMM that eliminates the water wastage or overuse
- ii. Can you explain and elaborate any methods or programmes you have as the department to prevent the water scarcity within BCMM?
- iii. How would you know that these methods or programmes are operating effectively and sufficiently?
- iv. As water scarcity is one of the major impacts caused by climate change. How have you prepared as BCMM in term of drought resistance or adaptation strategies or plans?
- v. How is your asset management?
- vi. How would you link your asset management plan such as your infrastructure development programme with your WC/WDM strategic objectives?
- vii. Are there any plan or programmes within BCMM to address issues concerning with the ever-increasing water demand and consumption?
- viii. How is the current state of your main water sources and infrastructure?
- ix. How are your current water resources and infrastructure state affecting the progress and performance of the municipality towards fulfilling the strategic goals of WC/WDM?
- x. Are there any improvements needed in your water sources and infrastructure?

- xi. What is the current status of your non-revenue water?
- xii. How does the municipality address the issue of non-revenue water in ensuring reduction of water loss within the system?

Appendix B – Ethics Forms



Human Ethics subcommittee
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NHREC Registration no: REC-241116-945

1 June 2020

Kwanele Mlonzale

Email: g17m8558@campus.ru.ac.za

Review Reference: 2019-0184-981

Dear Ms. Greyling

Title: Water Conservation and Demand Management in Buffalo City Metropolitan Municipality

Principal Investigator: Ms Leticia Greyling

Collaborators: Mr Kwanele Mlonzale,

This letter confirms that the above research proposal has been reviewed and **APPROVED** by the Rhodes University Ethical Standards Committee (RUESC) – Human Ethics (HE) sub-committee.

Approval has been granted for 1 year. An annual progress report will be required in order to renew approval for an additional period. You will receive an email notifying when the annual report is due.

Please ensure that the ethical standards committee is notified should any substantive change(s) be made, for whatever reason, during the research process. This includes changes in investigators. Please also ensure that a brief report is submitted to the ethics committee on the completion of the research. The purpose of this report is to indicate whether the research was conducted successfully, if any aspects could not be completed, or if any problems arose that the ethical standards committee should be aware of. If a thesis or dissertation arising from this research is submitted to the library's electronic theses and dissertations (ETD) repository, please notify the committee of the date of submission and/or any reference or cataloging number allocated.

Sincerely,

Prof Arthur Webb

Chair: Human Ethics Sub-Committee, RUESC- HE



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01 April 2020

Dear

Re: Invitation to participate in research study

You are invited to participate in a research study entitled WATER CONSERVATION AND DEMAND MANAGEMENT (WC/WDM) WITHIN BUFFALO CITY METROPOLITAN MUNICIPALITY. The aim of this research is to assess the current BCMM WC/WDM strategy, evaluate the progress and challenges encountered during implementation of the strategy to date, identify constraints and/or opportunities with regards to WC/WDM and make recommendations for improved practices at BCMM. Your participation and cooperation are important so that the results of the research are accurately portrayed.

The research will be undertaken using data collection method (document analysis) and individual interviews with BCMM officials and the data to be collected from this research will be BCMM WC/WDM strategy, water audit, reports, non-revenue/water loss quarterly reports, and infrastructure maintenance project reports (such as water pipeline and meter replacement, retro-fittings and pressure management). (state the nature and type of data to be collected). Your identity will be treated with complete confidentiality. The collection of this data will require about one (1) hour of your time to complete.

We will provide you with all the necessary information to assist you to understand the study and explain what would be expected of you (the participant). These guidelines would include the risks, benefits, and your rights as a study subject. Furthermore, it is important that you are aware that this study has been approved by a Research Ethics Committee of the university.

Participation in this research is completely voluntary and this letter of invitation does not obligate you to take part in this research study. To participate, you will be required to provide written consent that will include your signature, date and initials to verify that you understand and agree to the conditions. Please note that you have the right to withdraw at any given time during the study without penalty.

Thank you for your time and I hope that you will find our request favourable.

Yours sincerely,

KWANELE MLOMZAILE
Research Student

LETICIA GREYLING
Supervisor



RHODES UNIVERSITY

INFORMED CONSENT FORM

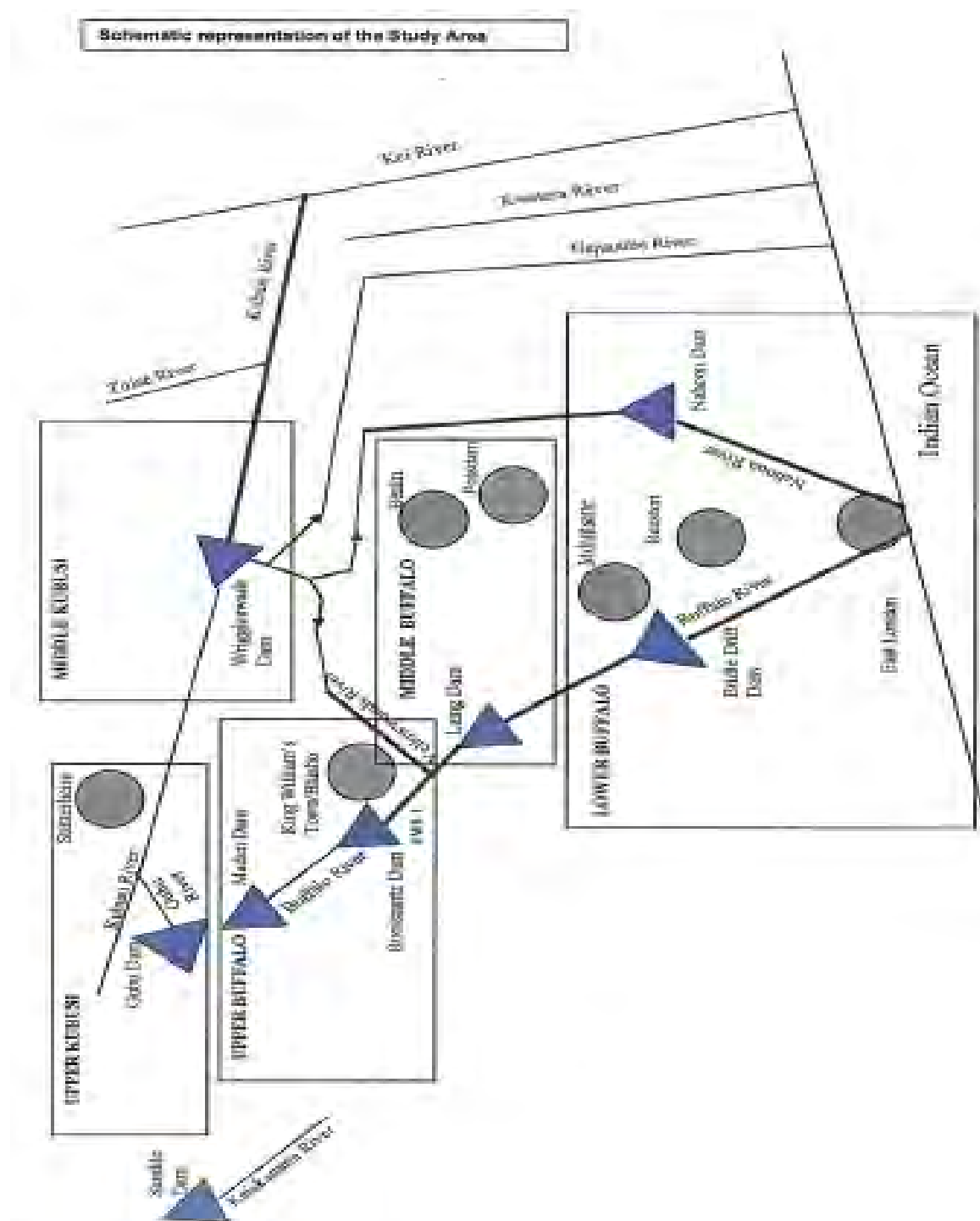
Rhodes Business School

Research Project Title:	WATER CONSERVATION AND DEMAND MANAGEMENT IN BUFFALO CITY METROPOLITAN MUNICIPALITY
Principal Investigator(s):	KWANELE MLOMZALE

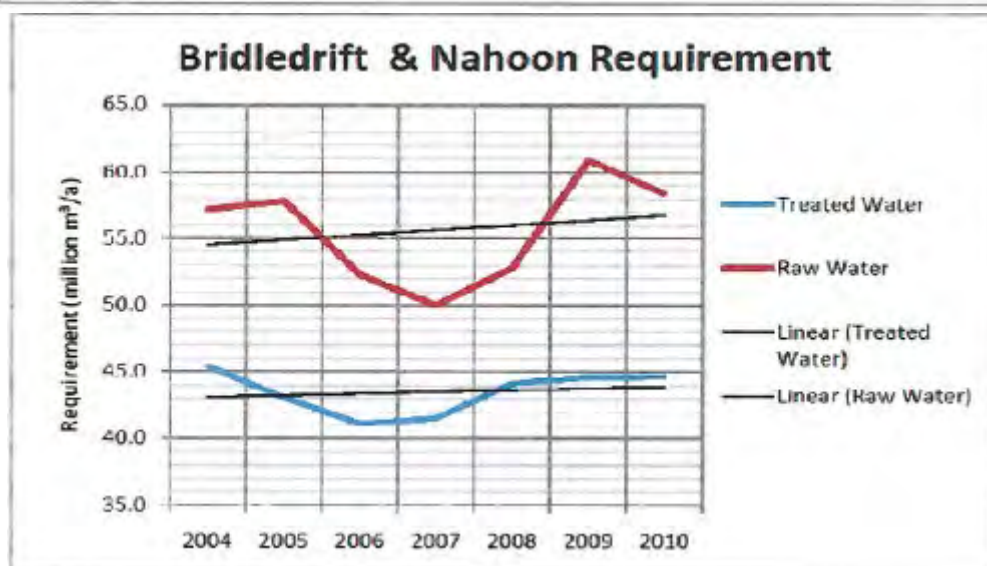
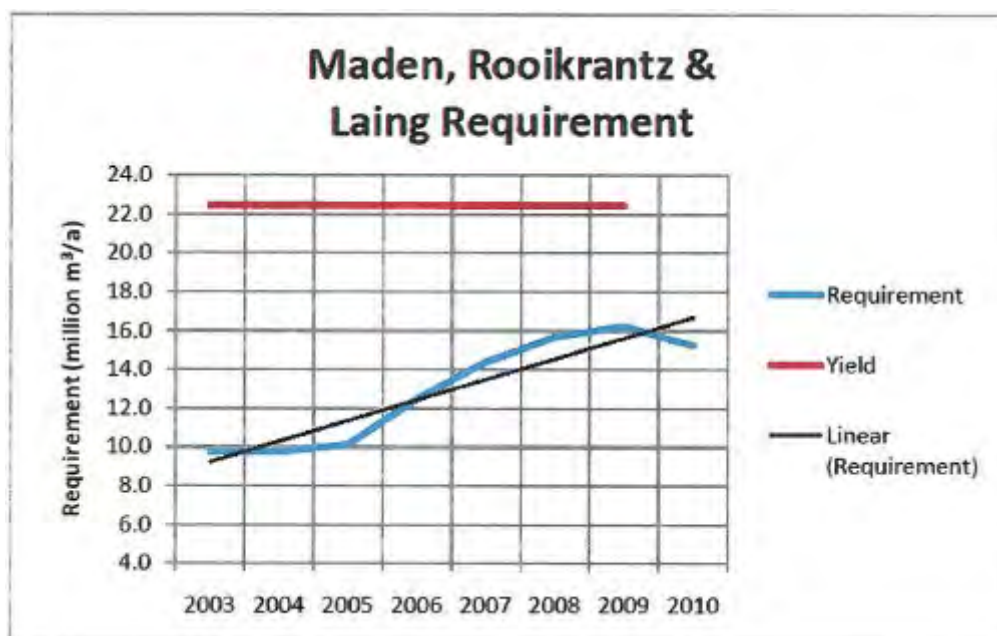
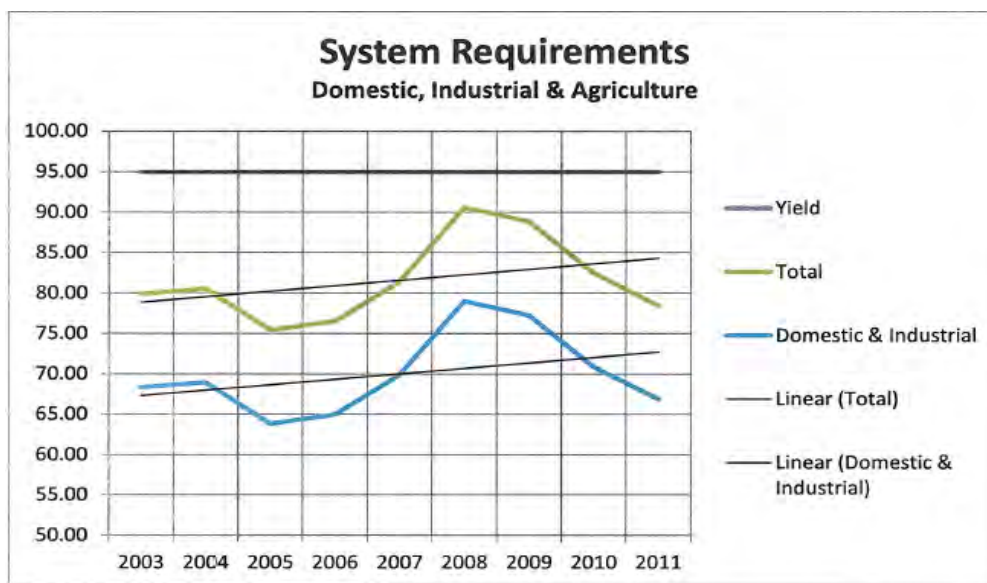
Participation Information
<ul style="list-style-type: none">• I understand the purpose of the research study and my involvement in it• I understand the risks of participating in this research study• I understand the benefits of participating in this research study• I understand that I may withdraw from the research study at any stage without any penalty• I understand that participation in this study is done on a voluntary basis• I understand that while information gained during the study may be published, I will not be identified• I understand that I will receive no payment for participating in this study

Information Explanation
The above information was explained to me by: KWANELE MLOMZALE
The above information was explained to me in: <input checked="" type="checkbox"/> English <input type="checkbox"/> Afrikaans <input type="checkbox"/> isiXhosa <input type="checkbox"/> isiZulu <input type="checkbox"/> Other:
and I am in command of this language
OR, it was comprehensibly translated to me by:

Appendix C – Water Supply Scheme Schematic Layout

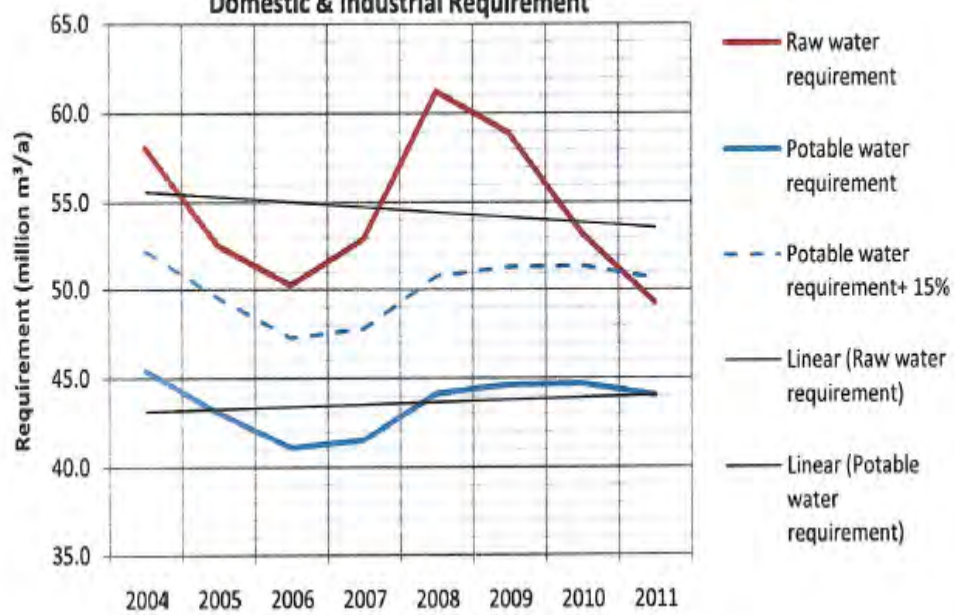


Appendix D – BCMM historical Raw and Potable Water Requirements



Bridledrift & Nahoon Dams

Domestic & Industrial Requirement



Appendix E – BCMM Water Balance

System Input Volume	Authorised Consumption	Billed Authorised Consumption	Billed Metered Consumption	Free basic
			Billed Unmetered Consumption	Revenue Water
		Unbilled Authorised Consumption	Unbilled Metered Consumption	Non Revenue Water
			Unbilled Unmetered Consumption	
	Apparent Losses	Unauthorised Consumption		
		Customer Meter Inaccuracies		
	Water Losses	Real Losses	Leakage on Transmission and Distribution Mains	
			Leakage and Overflows at Storage Tanks	
			Leakage on Service Connections up to point of Customer Meter	

Appendix F – BCMM Water Supply Services Organogram

